50 Cents

February, 1960

Welding Engineer

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TEMPILSTIKS° provide a simple and accurate means of determining preheating and stress relieving temperatures in welding operations. Tempilstiks° are widely used as a standard method of checking temperatures in all heat treating—as well as in hundreds of other heat-dependent processes in industry. Available in 80 different temperature ratings . . . . . $2.00 each.

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200 amps at 25 volts on a 100% duty cycle! Ranges from 30 to 225 amps. You can use all types of electrodes in all positions having the advantage of being able to choose either polarity (straight or reverse).

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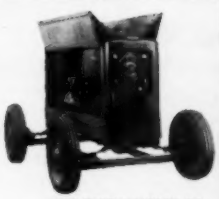

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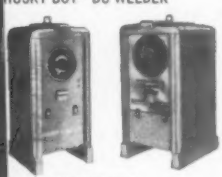

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Yes, I'd like to know more about the following Hobart equipment:

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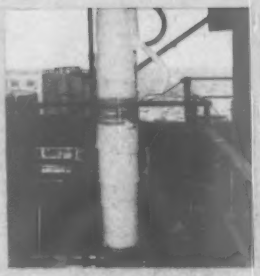
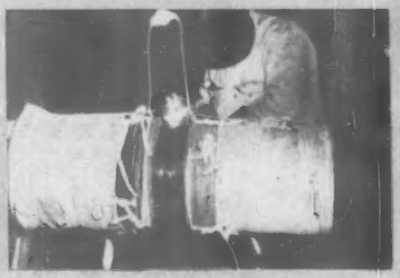


Where's the induction heater? On the ground – a full 100 feet below! "Impossible" locations become workable when a Hobart unit is on the job.



See how easily coils slip apart to facilitate welding. Further savings result when two or three joints are treated simultaneously.

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- **HEAT TREATING**
- **STRESS RELIEVING**
- **SHRINK FITTING**

Lets you do a completely programmed and recorded job from start to finish with guaranteed results.

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NO LARGE CABLE SIZES

Uses small diameter wire and works in close, hard-to-get-at places as far as 200 feet away from the unit. Hobart also gives you mobility for heat treating on the job site and eliminates need for any special incoming electric lines to operate the equipment. Hobart's new model MIA-50-S provides completely automatic, accurately controlled preheating and stress relieving. Takes only a few turns with small diameter wire with a substantial savings in power costs.

USED BY Atomic Energy Plant Contractors — Missile Manufacturers — High Pressure Vessel and Piping Fabricators — Oil Companies — Refineries and Pipe Lines — Heavy Machinery and Weldment Manufacturers — Heavy Engineering and Construction Firms and wherever there are operations requiring the reduction of thermal stresses and removal of hard zones.

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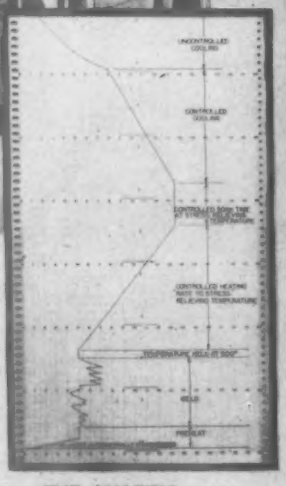
Why not check with Hobart on the many ways 400 cycle induction heating can be profitably used on various applications — no obligation.

YOU KNOW WHAT'S HAPPENING EVERY MINUTE

The ElectroniK Strip Chart Program Controller makes a permanent record of every phase of every operation. It also measures what the temperature of the work is, what it should be according to your control setting, and then compensates for any variation.



THE AMAZING ElectroniK STRIP CHART

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Tell us how your induction heater works on_____

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CITY_____ ZONE____ STATE_____

Any size joint can be heated, properly cooled and stress relieved through Hobart's proportional control system. This 24" dia., 3/8" wall pipe and 3" wall check valve were treated perfectly.

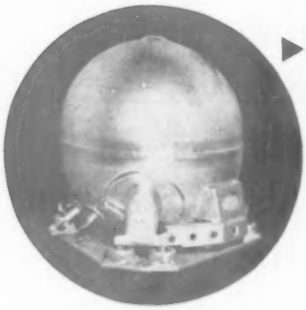
VOL. 45—No. 2

Welding Engineer

The magazine of joining and severing of materials

This is welding: February, 1960

Cover: Weldor joins solid stainless insert to mild steel vane in pump-turbine runner. See page 32.



Oxygen converters for high-altitude breathing 29

A quiet revolution from gaseous oxygen in cylinders to liquid oxygen has been taking place in the military aviation field. Author **J. P. Green** reports on the fabrication of one such Tig welded converter ready for use in advanced jet fighters and bombers.

Advantages gained when redesigning turbine runners 32

Redesigning for welding, whether in the product or the machine itself, continues to be the keystone of lower manufacturing costs. **Fritz M. Hessemer's** paper, which won the second award in the Lincoln Foundation's annual machine design award program, points up this proven fact.

★ (For a reprint of this article, circle number 248.)

A guide to preheat 34

What is preheat; where and why is it used; what are its benefits; which procedure is best for its application? These are some of the questions answered in this article on one modern-day method of controlling weld quality.

★ (For a reprint of this article, circle number 249.)

Super girders fabricated for national park bridge 38

Originally calling for 1,377,000 lb of riveted steel plate, this bridge was redesigned for arc-welding, resulting in an immediate savings of 118,000 lb of steel —as well as adding strength, better appearance and further savings. Author **John R. Gray** reports the specific welding details for this glacier bridge.

Production, properties, uses of build-up electrodes 40

Build-up electrodes increase in importance as the rebuilding and reclaiming of worn steel parts becomes more and more of a standard maintenance procedure. Metallurgist **Albert J. Zvanut** details the factors involved in the manufacture and application of these electrodes.

★ (For a reprint of this article, circle number 250.)

Welding control makes its own welding conditions 42

Consistent quality, less required inspection, no rejects. These are the main results claimed for a new spot welding feedback control which automatically compensates for variations in actual conditions normally affecting weld quality.

Also in this issue:

Important facts about industrial adhesives 31
Careful assembling can cut fabrication costs 48
Hardening without hardfacing 50
Silver alloy reclaims eroded brazed parts 57
Multi-spot welders for the English Austin 58
Chicago high school trains future weldors 68

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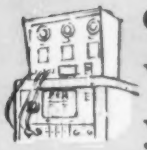
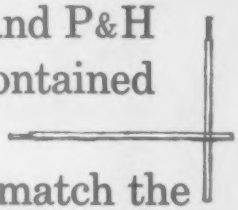
If profitable arc-welding is important to you, then you ought to investigate the complete line of modern Harnischfeger



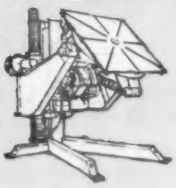
equipment. For example, P&H weld-programming with motorized rheostat or sequence-timers enables you to weld Space Age and other super-critical metal automatically! Or you can automate your welding

with P&H punched-tape control. Both are infinitely versatile and standardize weld quality at levels

impossible with manual controls. P&H also offers you industry's most complete line of industrial welders — 1 to 750 amps. — AC, DC, or dual AC/DC machines with h-f, spot gun, and gas and water controls. And P&H engine-driven welders give you compact, self-contained 25- to 500-amp. weld-power for field jobs. The



different types of P&H electrodes enable you to match the



analysis and properties of many weldable parent metals. And you can cut welding labor and overhead costs in half with P&H welding positioners. So...

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Welding Engineer

America's pioneer publication which, combined with The Acetylene Journal, has been devoted to the interest of the welding and allied industries since 1898

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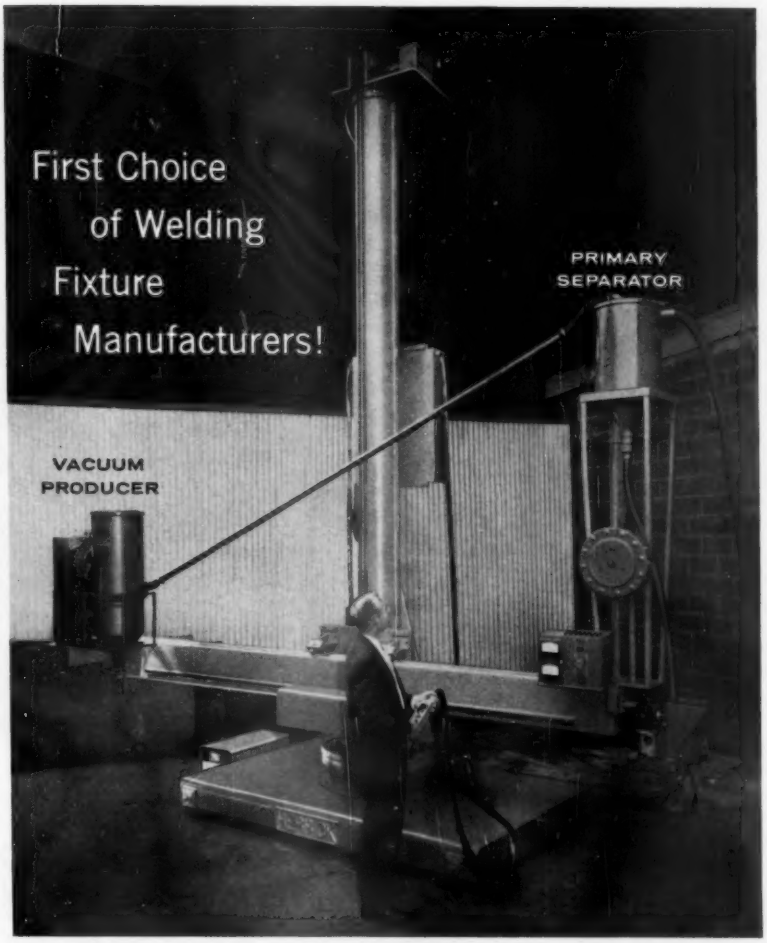

INVINCIBLE UNITS

Automatically Reclaim Flux

This automatic ram type manipulator made by C. B. Herrick Manufacturing Corp., Cleveland, is used for welding steel plate bridge girders. Mounted on the carriage, an Invincible Flux Recovery Unit travels with the welder along the full length (up to 130 feet) of the girder. It recovers all unfused flux . . . removes powder . . . and returns slag-free, dust-free flux to the welder automatically, in a continuous flow.

Fixture manufacturers—and users—specify Invincibles because they are engineered specially for handling abrasive materials and for continuous operation. Their rugged construction assures years of full-time operation—no loss of production time.

Savings in reclaimed flux alone pay their cost in a few months, even weeks. In addition, Invincibles save costly man-hours over manual methods, speed-up production, minimize rejects.

In 14 standard automatic and manual models (1½ to 7½ H.P.). Accurate free surveys of your submerged arc welding operations can be made on short notice. Resident engineers in all principal cities.

Send for Invincible Flux Recovery Equipment Folder.

INVINCIBLE VACUUM CLEANER MFG. CO.
DOVER, OHIO

Compact, portable Victormatic weighs about 100 lbs., measures 10" x 18" x 20", is amazingly easy to operate.

VICTORMATIC is a portable, semi-automatic, sensibly priced and specifically engineered for hardfacing with continuous coil, fabricated-tube wire. You buy it for less than a welder's monthly wage and it will pay for itself in a matter of weeks by . . .

- boosting production. Handles hardfacing jobs from build-up to finish overlays, semi-automatically.
- eliminating stub-end waste and rod changing time.
- reducing costly equipment downtime.

VICTORMATIC ties in, *in minutes*, with almost any standard 300 amp. welder — rectifier type, gas, or electric. It is ideal for field use with gas driven, portable welder. Operates as full-automatic when coupled with suitable positioning device. Adaptable for submerged arc and drawn wire welding.

Ask your Victor dealer for a demonstration today . . . see for yourself how much faster and cheaper you can hardface with a VICTORMATIC.

Profitable dealerships open; inquire now!

For Top Performance use Victor Automatic and Semi-Automatic Wires. Complete line of continuous-coil wires for hardfacing and build-up; give you high deposition rate and notably low spatter loss. Victor guarantees consistent uniformity from coil to coil, regardless of lot date. For welding and wear, compare Victor wire with any other wire — on your job.

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H-64

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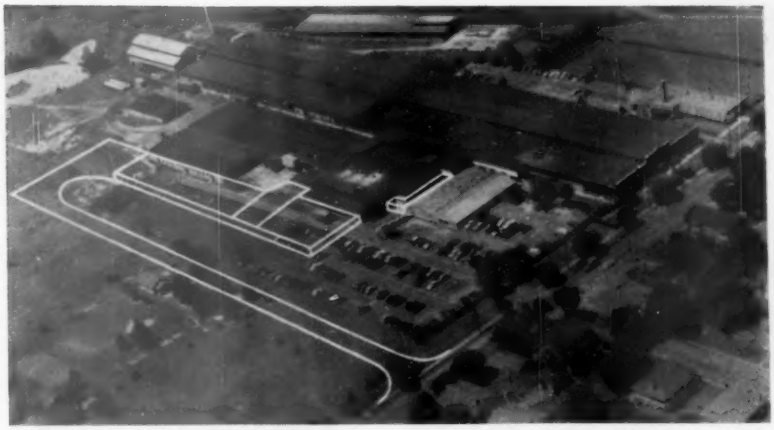


OUTLINED area shows space earmarked for development at McKay Co.

McKay Co. starts work on $500,000 expansion of production facilities

Ground has been broken in York, Pa., by the McKay Co. for a $500,000 expansion program which will include new facilities to provide faster service to its customers.

When completed, the construction will include a greatly enlarged laboratory for research in electric arc welding technology and new manufacturing facilities incorporating specially designed high-speed, high-temperature electrode drying and baking equipment.

New materials handling facilities are being installed within the plant, and new truck and rail loading docks will speed delivery from the plant to customers. The electrode production areas will cover approximately 30,000 sq. ft.

The new welding laboratory will be equipped for welding by automatic and manual welding processes and will be used to test the company's experimental and production welding products. The laboratory staff has been expanded to keep pace with the general increase in production capacity.

Layout has been planned to accommodate groups of visitors, and the laboratory is intended to serve additionally as an educational center for McKay salesmen, field engineers, and distributors' representatives.

Move to modify welding equipment specifications

Manufacturing specifications of arc welding apparatus should better reflect government requirements, it was decided at a recent meeting of the Arc Welding Section of the National Electrical Manufacturers Association in Chicago.

To move toward this objective, member firms unanimously approved their technical committee's proposal that it "review and develop recommendations and cooperate with federal and military bodies in the preparation of new and revised specifications covering arc welding apparatus for federal and military requirements." (See "Between Passes" page in this issue for more on standards and specifications.)

The committee will also advise the Arc Welding Section on standards, codes and other technical matters pertaining to the apparatus.

In another report, the statistical committee outlined a new and simplified system for reporting welding machine sales. Members will receive this information for letter ballot and approval.

R. T. Brown and L. D. T. Berg, 1959 chairman and vice-chairman respectively, were re-elected to their positions for 1960. N. C. Miller has been appointed section representative to the NEMA board of governors.

Defense division of Budd renamed SpaceAtomics

SpaceAtomics is the new name Budd Co., Philadelphia, has given its Defense Division. Coincident with the name change, Budd's aircraft, missile ground handling equipment sales, contract administration, and engineering responsibilities were transferred from the company's Railway division to the SpaceAtomics division, which is headed by J. B. Darrah.

The change was made to identify the division's name more closely with its new activities, which are currently expanding in both the space and atomic areas.

Accelerated research is taking place in the forming and joining of exotic metals such as beryllium, columbium, molybdenum, and tantalum for applications on missiles and super- and hypersonic aircraft.

Other division developments include fabrication and machining of complex structures in a large variety of metals and development of a lightweight, welded, stainless steel sandwich material which has been successfully flight-tested as a speed brake on Convair's F-106 supersonic delta wing interceptor.

Another company change has seen the Budd's Tatnall Measuring Systems Nuclear Systems divisions merged into a single entity, named Instruments division. This merger was effected, the company said, to eliminate overlapping sales and management functions and thus achieve greater administrative efficiency and economy.

DR. Hassan Afshar, former minister of labor and currently a member of the Iranian parliament, Teheran, Iran, and dean of the law school at the University of Teheran, was a recent visitor to the East Chicago, Ind., plant of Graver Tank & Mfg. Co., Div. of Union Tank Car Co. Charles W. Springer, Graver executive for overseas operations, explains fabrication of a stainless steel vessel to (from left): Cyrus A. Ansary, Iranian lawyer and U. S. State Department interpreter; Dr. Afshar; Sabir M. Amawi of Graver overseas operations; and A. L. Bradburn, Calumet area representative for the Institute of International Education, which arranged Dr. Afshar's visit.

Outnumbered . . .

MEMBER of a vanishing clan is weldor Margie Gibbs of Rocketdyne Div., North American Aviation Inc., Los Angeles. Mrs. Gibbs, who started welding 19 years ago, works in the division's production development laboratory. A welding analyst, she evaluates procedures, recommends welding practices, and works on special jobs of intricate nature and research projects.

Second copper and brass competition announced

The Copper & Brass Research Association has inaugurated the second annual competition to honor the year's most outstanding contribution to the use, application, or metallurgy of copper and copper-base alloys. Winners of the competition will receive $1,000 and a bronze award, which will be presented on May 17 at the association's annual meeting at Hot Springs, Va.

Consideration in the contest will include contributions to the metallurgy of the copper metals; improvement of fabrication methods in the manufacture of copper-based products; and contributions to science or research through the application of the copper metals.

Last year's award was given in recognition of the Seagram Building in New York City, the world's first all-bronze skyscraper. Closing date for nominations is March 31.

New plant to feature direct welding operation

National Cylinder Gas Div., Chemetron Corp., Chicago, is building the first plant ever designed for welding sections of railroad track immediately upon their emergence from the steel rolling mill. The project, undertaken jointly with the Colorado Fuel & Iron Co., Denver, is at Minnequa, Colo.

The standard 39-ft rails will move directly from CFI's rolling mill into the new plant for welding, after which they will be shipped on flat cars or gondolas to points of track-laying by railroads.

Welding of rail at the mill site not only eliminates the expense of moving equipment from job to job, but permits permanent use of a trained welding crew and assures a constant supply of rails to be welded, the companies stated.

National Cylinder obtained exclusive U.S. manufacturing rights to the patented welding system from a Swiss firm two and a half years ago. The system completes an entire welding operation in about four minutes.

New nickel mine due to operate this year

Scheduled to commence operations this year is International Nickel Co.'s new Thompson mine in northern Manitoba province. The mine, called the largest nickel-producing operation in the world next to Inco's operations in the Sudbury district of Ontario, is expected to have an annual capacity of 75,000 lb.

Along with the facility are to be a complete community, including a shopping center, hotel, modern water and sewage systems, theater, hospital, and administration building. Planned for an initial population of 8,000, the town will have four schools, one of which has been completed and turned over to provincial and local authorities.

The quarter-mile long electrolytic refinery will employ a new nickel refining process making possible the direct electrolysis of nickel matte, thus eliminating high-temperature oxidation and reduction operations.

COMING EVENTS

FEB. 3-4: Midwest Welding Conference, Illinois Tech Chemistry Building, Chicago.

FEB. 16-18: First National Symposium on Nondestructive Testing of Aircraft and Missile Components, sponsored by Southwest Section of the Society for Nondestructive Testing, Inc., and Southwest Research Institute, Hilton Hotel, San Antonio.

APRIL 4-7: 1960 Atomic Exposition, New York Coliseum, New York City.

APRIL 25-29: 41st Annual Convention, AWS, The Biltmore Hotel, Los Angeles.

APRIL 26-28: AWS Exposition, Great Western Exhibit Center, Los Angeles.

MAY 5-7: NWSA 16th Annual National Convention, Palmer House, Chicago.

MAY 25-26: Symposium on Refractory Metals and Alloys, McGregor Center, Wayne State University, Detroit.

Buckeye tools launches mobile field clinic

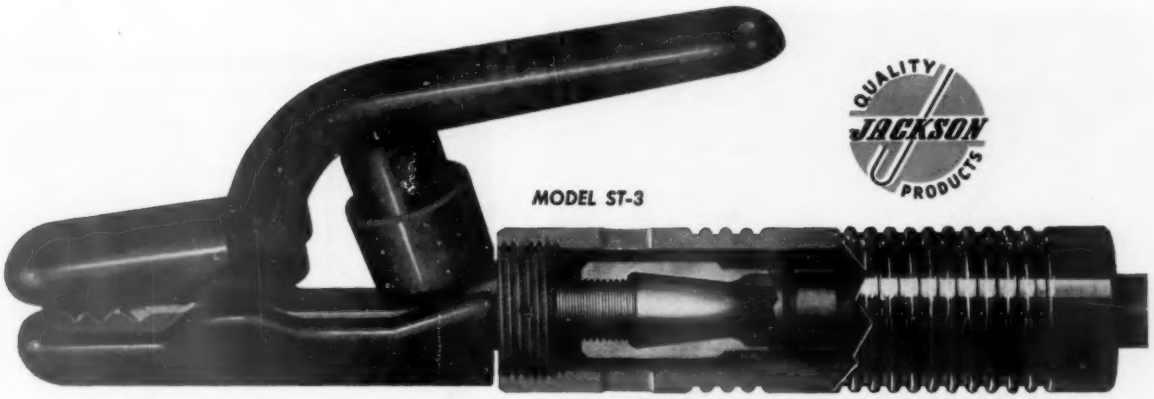
A mobile "field clinic" forming a two-way communications link between customers and factory in the application of portable air tools has been developed by Buckeye Tools Corp., Dayton, Ohio.

The firm recently equipped a station wagon with representative industrial tools and accessories and is using the wagon to contact customers and field offices on a regular schedule.

Purpose of the program, according to the company, is to provide the right tool for the right job. The unit brings purchasers and members of the firm's field sales organization up to date on new products, provides refresher instruction and service tips on older products, advises on special applications, and relays customer suggestions back to the factory.

All-aluminum boat

WHITE Gold, a 35-ft pilot boat constructed by Higgins, Inc., New Orleans, for Kaiser Aluminum & Chemical Corp., Oakland, Calif., is made completely of aluminum. The craft, weighing 19,700 lb., was constructed primarily from aluminum alloy 5083, a high strength weldable metal developed by Kaiser. Stiffeners and framing were formed from ¼-in. plate.



new . . . Sealed Tight

JACKSON SERIES ST electrode holders offer a *Sealed Tight* mechanical cable connection that gives you practically one-piece conductivity between cable and holder. Tongs are of heat-treated 98% copper alloy.

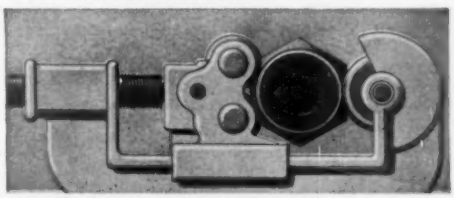
The stripped cable strands are completely *Sealed Tight* within a *connection nut*, making all-around *tight* metal-to-metal contact with the holder tong, *sealed* against moisture and dirt. The cable jacket is also *Sealed Tight*. The connection nut, by providing an all-around *tight* support of the cable jacket, allows no strain on the cable strands which usually occurs through flexure and tension.

This cable connection is quick and lasting, requiring no maintenance during the normal life of copper or aluminum cable.

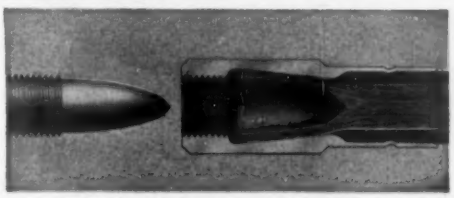
Large, ventilated handle threads onto a non-conductive asbestos bushing, has no direct metal contact with tong or cable connection, resulting in an extremely cool working holder. Should the "stinger end" of the holder require service of any kind, it may be quickly replaced without disturbing the actual cable connection. This important feature greatly reduces holder down-time and effects savings in cable cost.

Copper alloy lower jaw terminates in a point, silver-plated for greatest conductivity. When nut is tightened, cable strands are equally disposed around this point, *Sealed Tight*.

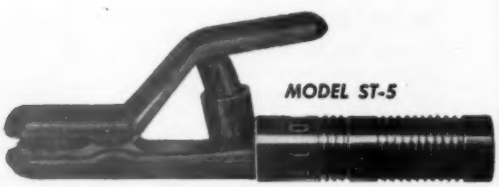
The nut extends backward, forming a ferrule around the cable jacket. This *Sealed Tight Connection Nut* is made in sizes to fit cables No. 1, 1/0, 2/0, and 3/0.



For a *truly permanent nut-to-cable connection*, the ferrule of the nut is crimped around the cable jacket, using Jackson's inexpensive, fast-acting crimping tool.



Detachable Stinger feature enables the operator to detach the "stinger end" by unscrewing it from the connection nut. The cable strands stay in place inside the nut.



Sold Everywhere by Better Welding Supply Dealers

MADE IN TWO SIZES . . .

Model ST-3, "Sealed Tight" Insulated Copper Alloy Holder Electrodes through ¼" • 300 Amps • 10" long

Model ST-5, "Sealed Tight" Insulated Copper Alloy Holder Electrodes through ⅜" • 500 Amps • 11½" long

Jackson Products

AIR REDUCTION SALES CO. A DIVISION OF AIR REDUCTION CO., INC.

WARREN • MICHIGAN

NEW M&T MUREX LINE STANDS OUT ...in design ...in construction ...in operation

Spot the welder you're interested in—check its superiorities against other machines on the market. You'll find features to make it easier to operate . . . to promote better welding. EXAMPLE: in heavy duty AC equipment, a sliding shunt moves only one-inch to cover full range of output—no laborious, time-consuming cranking needed. EXAMPLE: in DC Rectifiers only highest quality hermetically sealed silicon diodes are used—their high efficiency and non-aging characteristic assuring superior welding performance, long life, and extremely dependable operation.

And don't overlook the built-in quality and careful attention to construction detail that mean long term, low maintenance operation. Send for your M&T Murex welding machine specialist . . . or for detailed data sheets.

M&T welding products

METAL & THERMIT CORPORATION
General Offices: Rahway, New Jersey

Attention Distributors
Learn how M&T is ready to help you profit from M&T MUREX machines and equipment. Get the facts. Write today.

1. AC-DC COMBINATION WELDERS
for convenience and economy

Patented dual transformer and hermetically sealed silicon diodes provide high arc stability and smooth steady arc for all AC and DC welding conditions. Stepless current control with single wheel adjustment. Available in 200, 300, 400 amp sizes.

4. MURETRAN* ALL-PURPOSE WELDERS *highly versatile units for any welding job*

Simple switching and plug-in controls permit rapid changeover from inert gas arc welding to manual, automatic, spot MIG and TIG welding. Unique plug-in control panel provides automatic timing of gas pre-flow, gas post-flow, high frequency drop-out and spot arc. Models for AC-DC or AC operation.
*Trademark

7. AC ARC WELDERS
for medium duty welding

Compact, all-purpose 180 amp portable arc welders for light manufacturing, maintenance or farm welding. Have automatic, built-in volt-arc characteristics that provide deep penetrating arc at high amperage, soft arc at lower settings. No moving parts, no maintenance.

10. HIGH FREQUENCY ARC STABILIZER
for inert gas arc welding

Converts any AC or DC welder for inert gas shielded arc welding. Completely automatic. Has foolproof gas after-flow device. Reduces gas costs. Remote control switch. Also available with water valve shut-off and timer. 230 volt, 0-600 amps capacity.

2. DC RECTIFIER WELDERS

for economical, heavy duty service

Hermetically sealed silicon diodes deliver high efficiency and non-aging characteristics. Instant recovery voltage provides high stability and easy striking and maintenance of the arc. Simple current range selectors and a single control knob simplify machine setting. Available in 200, 300, and 400 amp sizes.

3. AC INDUSTRIAL ARC WELDERS

for heavy-duty production welding

Unique transformer design with patented dual coil produces high arc stability for smooth, steady welding. No moving coils: steel shunt travels only one-inch to provide full stepless range of output. Forced air cooling. Instant arc starting. Models with 200, 300, 400 and 500 amp rated output.

5. INERT ARC AC WELDERS

for heavy-duty inert gas arc welding

Foolproof, built-in gas afterflow device eliminates complicated timers. Stepless amperage control provided by steel core which slides only one-inch for full range. Automatic remote control systems operate gas, water, high frequency and primary power from torch. May be used for metallic arc welding. Models with 200, 300, and 400 amp rated output.

6. AC ARC WELDERS

for production, maintenance and shop welding

Wide current range from 7 to 300 amperes. Delivers 200 amperes at 50% duty cycle. Automatic built-in voltage control gives deep penetrating arc at high outputs, soft arcs at lower settings. 66 heat settings.

8. AC ARC WELDERS

complete, portable welding outfit

Low cost complete welding outfit for light requirements. Good penetration on metals up to ¼-inch plate. Also available: M&T Model 91 Arc Torch for brazing, soldering and heating work. Rated to 95 amp output.

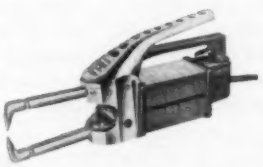
9. HIGH FREQUENCY ARC STABILIZER *for metallic arc welding*

Gives instant start with any AC or DC welder, any electrode. Stabilizes arc to prevent burn through on low-current settings for thin gauge welding. Remote control available. 230 volts, 0-600 amps capacity.

11. PORTABLE SPOT WELDER

for sheet metal and wire

Simple, light and rugged. Fixed upper tong is positioned on exact welding spot, providing better contact than welders that must be brought up to the work. Lower jaw comes up to exact underside spot. Welds mild steel, stainless, and galvanized iron to ⅛-inch combined thickness. Wide range of tong configurations.



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METAL & THERMIT CORPORATION
General Offices: Rahway, New Jersey

I am particularly interested in the equipment checked below.

☐ Have representative phone for appointment. ☐ Send data sheets.

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Phelps Dodge Habirprene* Arc Welding Cable
lasts longer under roughest working conditions!

The durable quality of Phelps Dodge Habirprene arc welding cable makes it ideal for use on jobs where welding cable undergoes severe physical wear and tear. Records show that Habirprene cable more readily absorbs heavy blows and weights, resists oxidation and damage caused by severe working conditions in shipyards, oil refineries, building construction and boiler-making plants. In some applications, Habirprene cable has lasted many times longer than rubber cable.

More than 10 years ago, Phelps Dodge pioneered Habirprene welding cable—the first real advance in this field. Today's Habirprene welding cable is the result of Phelps Dodge development and manufacturing experience devoted over the years to providing an arc welding cable of superior quality with a proven record for safety, dependability and long life. This cable meets all requirements of A.S.T.M. D752.

See your authorized Phelps Dodge distributor for hard-wearing, long-lasting Habirprene arc welding cable with indelible gold markings. Phelps Dodge also makes a full line of rubber arc welding cable and welding power supply cable. All these cables are available from stock.

*NEOPRENE

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WELDING ENGINEER

Your February, 1960

Weld World

As WE went to press, these were the industry's latest developments:

. . Another casualty of the price structure of the mild-steel electrode business: Champion Rivet Co., Cleveland. The firm has discontinued manufacture of such electrodes for the domestic market. It continues in the alloy and stainless electrode field.

. . Lenco, Inc., Jackson, Mo., has purchased all assets of Pike Products, Inc. (formerly H. J. Wagner Products Co.). Lenco will resume manufacture of Pike products under the Pike name in addition to the present Lenco line of Hi-Amp welding accessories.

. . National U.S. Radiator Corp. has sold to Crane Co., Chicago, all its operating assets. For $15 million in cash, plant equipment and inventory have been transferred as of Feb. 1. Involved in the sale were all of National's divisions, including Plastic Metals, Johnstown, Pa., which manufactures powdered metals for various applications —among them coatings for welding electrodes.

. . Aluminum pig prices were increased 1.3 cents per pound to 26 cents by Aluminum Co. of America, with other major producers soon following. Despite increase, Alcoa described aluminum prices as one of the few commodity costs not reflecting inflationary spiral of recent years. Meanwhile, vigorous growth in aluminum sales for 1960 was predicted in virtually every marketing area by Derek Richardson, of the Metals Div., Olin Mathieson Chemical Corp.

. . Harnischfeger Corp., Milwaukee, reported its total sales for all products were up more than 20% over 1958. Among the divisions, welding equipment showed "important strides in growth and development."

. . A long-predicted merger was approved when stockholders of General Dynamics Corp. and Material Service Corp. accepted the plan first proposed about a year ago. General Dynamics is the parent company of Liquid Carbonic Div., Chicago (as well as of Convair, Electric Boat and others), and Material Service is a Chicago-based building-materials firm.

. . Victor Equipment Co., San Francisco, expects its 1960 sales to be up about 10% over 1959, which saw a 20% increase in profits over 1958.

. . Hamilton Standard, division of United Aircraft Corp., Windsor Locks, Conn., has acquired exclusive North American rights to an electron beam process developed by Carl Zeiss Foundation, West Germany. Manufacture begins this year. Sales and promotion will be carried on by Hamilton-Electrona, Inc., 40 Wall St., New York City.

. . A government-owned metal-working plant in Warren, Ohio, has been acquired by Bridgeport Brass Co., which will turn the facility into an aluminum mill.

1ST

IN

QUALITY

AND

PRODUCTION

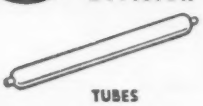
HARRISBURG CYLINDERS

Because Harrisburg Steel has never settled for anything less than the best in quality controls and production methods, the service life of their gas cylinders, which is usually over 30 years, has become the basis of standards for the industry. No other cylinder manufacturer can make this claim for only Harrisburg and Taylor-Wharton, both divisions of Harsco Corporation, have made cylinders for over 30 years.

More than a Century in Harrisburg 8, Pa.

H HARRISBURG STEEL CO.

Division of HARSCO CORPORATION



TUBES

TRANSPORTS

FLANGES

COUPLINGS

30 YEARS AGO

(Taken from WELDING ENGINEER *of February, 1930)*

— 30 YEARS AGO —

C. F. Smith, manager of The Sight Feed Generator Co., West Alexandria, Ohio, reports that his firm has supplied the U.S. Army Air Service with a number of portable acetylene generators for welding repair work on aircraft.

— 30 YEARS AGO —

Among those presenting papers at the Second Annual Conference on Welding Methods, held at Oregon State Agricultural College in Corvallis, were C. M. Taylor, vice-president of The Lincoln Electric Co.; A. G. Bissell, formerly consulting engineer of Westinghouse Electric & Mfg. Co.; and H. S. Fuller of the Stoody Co.

— 30 YEARS AGO —

The Cleveland School of Welding, Inc., which is the incorporated name of what was formerly known as the Cleveland Welding School, had an exhibit at the 1930 Cleveland Automobile Show of oxy-acetylene cutting and welding equipment used in the automotive field. Messrs. Randall and Scott were in charge of the booth.

— 30 YEARS AGO —

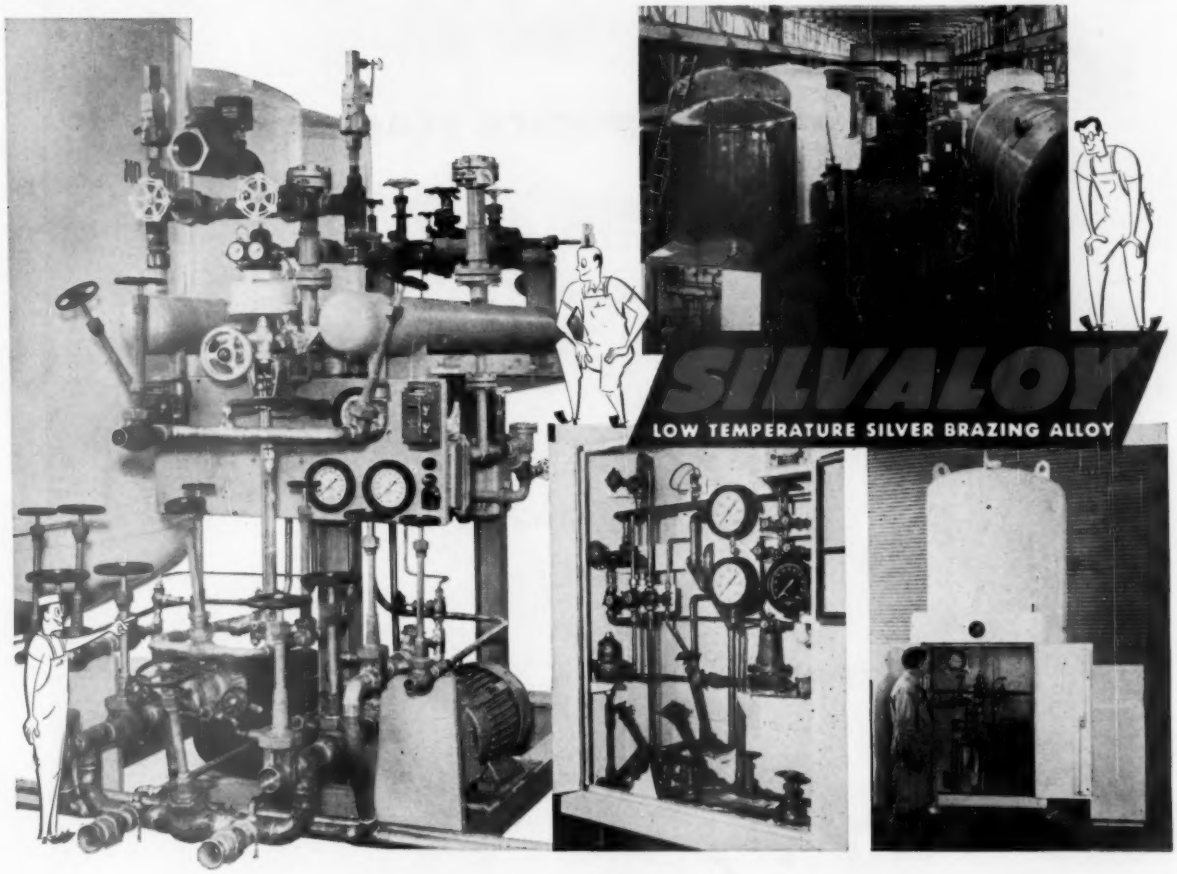
Robert E. Kinkead, arc-welding specialist and consulting engineer, has moved his Cleveland office to the Builders' Exchange building. He has also opened a Chicago office at 330 N. Western Ave.

— 30 YEARS AGO —

Charles T. Marsh has been transferred from the experimental department of The Taylor-Winfield Corp. at Warren, Ohio, to the sales and service force of that company. He is now located with Denton & Anderson Co., Chicago, distributors of Taylor-Winfield welders in the Chicago area.

— 30 YEARS AGO —

In announcing competitive examinations for a senior welding engineer, the United States Civil Service Commission posted an entrance salary that is higher than that paid to any other engineers under civil service. Those interested in the progress of welding will view with satisfaction the government's attitude toward this field of engineering.



SILVALOY BRAZING SAFEGUARDS JOINT STRENGTH OF RYAN CRYOGENIC VESSELS

The liquefied gas storage vessels manufactured by Ryan Industries, Inc., foremost manufacturer in this field, are subject to pressures to 500 p.s.i. — temperatures to minus 320°F. and vacuum less than 10 microns absolute pressure. The joints in the "plumbing and valving" of these vessels *must* safely withstand the extremes in temperature and pressures encountered in the storage and transfer of liquefied gases.

Ryan Industries depends upon Silvaloy Brazing Alloys and Fluxes to provide the necessary extra strength and leakproof characteristics required in joining valves, regulators, filters, thermometers, gauges, level indicators and fittings in the control cabinet. The quality of Ryan products is *insured* — with Silvaloy joints—*as strong as or stronger than the parent metals.* Silvaloy Brazing Alloys and Fluxes are helping to speed production, lower costs and improve results in many fields. Call your nearest Silvaloy Distributor for information or assistance.

RYAN INDUSTRIES, INC.

of Cleveland, Ohio, manufacture liquefied gas storage vessels ranging in capacity from 3000 to 1,500,000 standard cubic feet.

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ENGELHARD INDUSTRIES OF CANADA, LTD. • TORONTO • MONTREAL

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Two complete reference manuals for low-temperature silver brazing and fluxing are available upon request. Send for either one or both.

★ ★ ★ ★ ★ ★ ★ ★ ★

ENGELHARD
INDUSTRIES, INC.
AMERICAN PLATINUM & SILVER DIVISION
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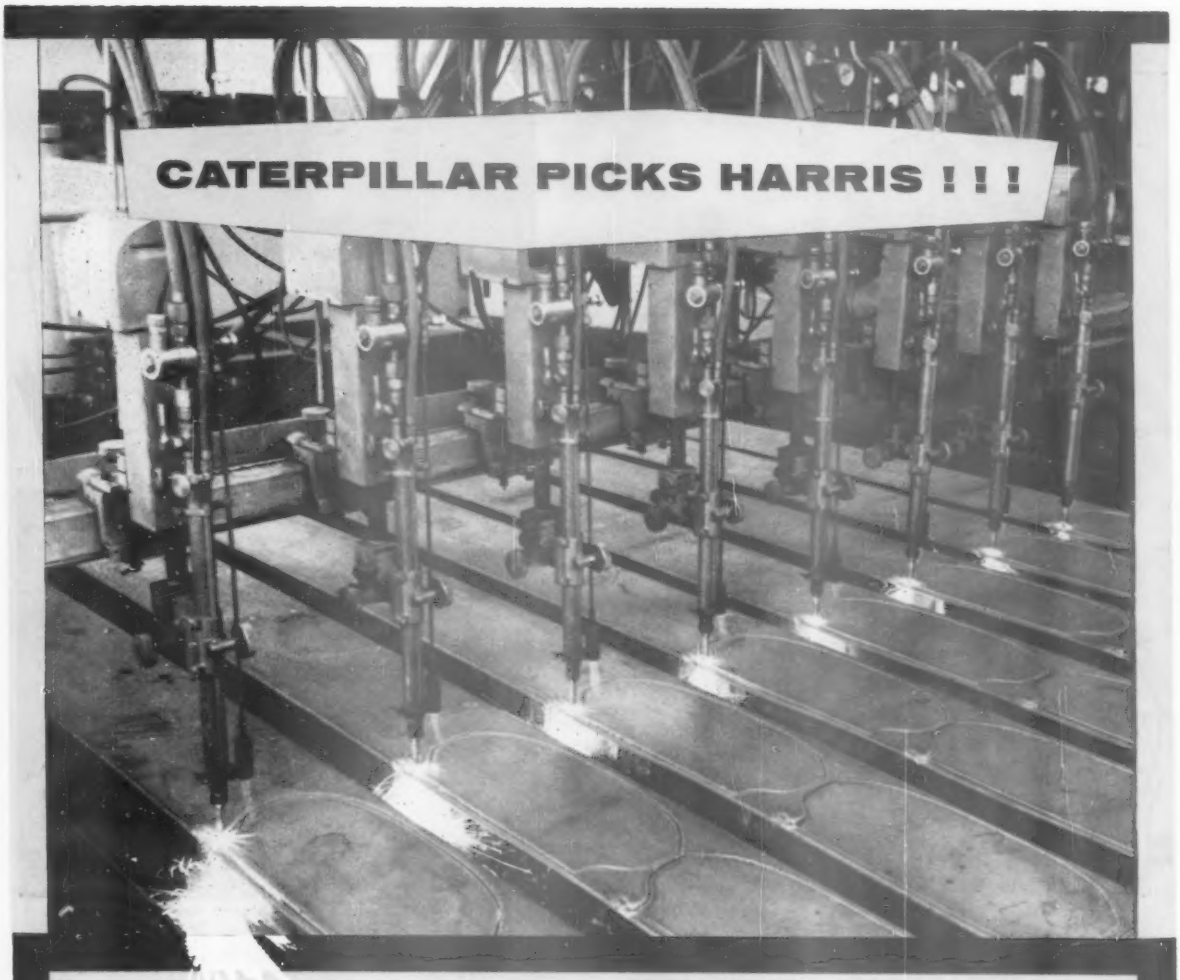

Photo courtesy Caterpillar Tractor Co.

For Speed and Economy in Flame Cutting Using Natural Gas

The use of Harris cutting torches accomplished the most economical balance between cutting speeds and oxygen consumption. Harris torches were selected over competing brands.

This installation permitted performance not otherwise possible and the gas savings are substantial.

For further information call your local Harris Distributor or write to us.

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HARRIS CALORIFIC CO.

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ATOM·ARC* Pipe Welding Alloys

*IRON POWDER LOW HYDROGEN ELECTRODES

provide x-ray quality welds — lower welding costs at

NATIONAL VALVE AND MANUFACTURING CO.

less rework, no grinding or chipping, faster deposition rates, are time savers that boost profits.

Photos Courtesy NATIONAL VALVE & MANUFACTURING COMPANY

National Valve and Manufacturing Co., fabricator and erector of quality piping for American industry, has consistently been among the leaders in the piping industry for the last half century. This large, engineering-minded organization maintains its position of leadership through research to constantly improve methods and facilities—testing and selecting the latest in materials that will provide their clients with the finest quality high pressure, high temperature piping.

NAVCO research into welding techniques and materials resulted in the selection of ATOM·ARC All Position Iron Powder Low Hydrogen alloys for handwelding of pipe fabrications and for field erection. The X-ray quality of ATOM·ARC weld metal eliminates needless rework. The flat, smooth bead contour makes slag removal easy, requires no costly and time consuming chipping and grinding, allowing weldors more time for welding. Even finish grinding of the final pass is eliminated. These cost saving properties of ATOM·ARC electrodes are amplified by the fast deposition rate achieved from the iron powder type coatings.

These are the facts NAVCO found in their search for better materials for high quality piping . . . facts which prove ATOM·ARC Iron Powder Low Hydrogen Alloys produce superior piping products. For your free copy of an informative and revealing report to piping contractors, write to:

Alloy Rods Company, P. O. Box 1828, York 2, Penna.

WORLD'S LARGEST SELECTION—IRON POWDER ALLOYS

ATOM·ARC 7018 Mo	AWS E7018-A1
ATOM·ARC 8018 N	AWS E8018-C2
ATOM·ARC 8018 CM	AWS E8018-B2
ATOM·ARC 9018 CM	AWS E9018-B3
ATOM·ARC 10018 MM	AWS E10018-D2
ATOM·ARC 12018 NMV	AWS E12018-G
ATOM·ARC "T"	AWS E11018-G
ATOM·ARC 502	AWS E502-16

Alloy Rods Company

YORK, PENNSYLVANIA • EL SEGUNDO, CALIFORNIA

NO FINER ELECTRODES MADE . . . ANYWHERE

Monautronic V-2 welding quality, cuts rejects and

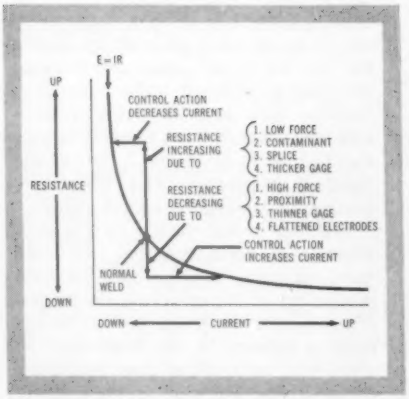
The new Monautronic V-2 welding control introduces the concept of feedback control to produce spotwelds of consistently high quality. It makes use of the latest advances in electronic computing to overcome automatically such obstacles to weld quality as line voltage fluctuation, electrode wear, variations in electrode tip force, surface finish and shunting.

The Monautronic V-2 compensates for undesirable variations usually encountered in resistance welding by maintaining voltage across a weld at a constant value. This constraint of voltage amounts to constraint of final weld temperatures, and such temperature control assures production of quality welds.

- **Automatic lockout**—occurs when process variations are so severe that the available current range would not cover the requirements for quality welding. The control detects extreme contamination, failure in the force system, overwelding, poor matching or fitup, and any other conditions that would result in substandard welds.
- **Automatic sequencing**—all provisions for single spot, roll spot or seam welding. Sequencing is 100% accurate, and exceeds NEMA standard specification 3B. Special sequence programming is available.
- **Transistorized design**—for high reliability, compactness, low power consumption.
- **Modular construction**—permits easy removal of the three modules and separate firing unit, simplifies maintenance.
- **Shock and vibration resistant construction**—for long, reliable service in even the most demanding applications.
- **Safety interlock**—for protection of personnel during tip dressing.
- **Tamperproof case**—prevents access to control by unauthorized personnel.

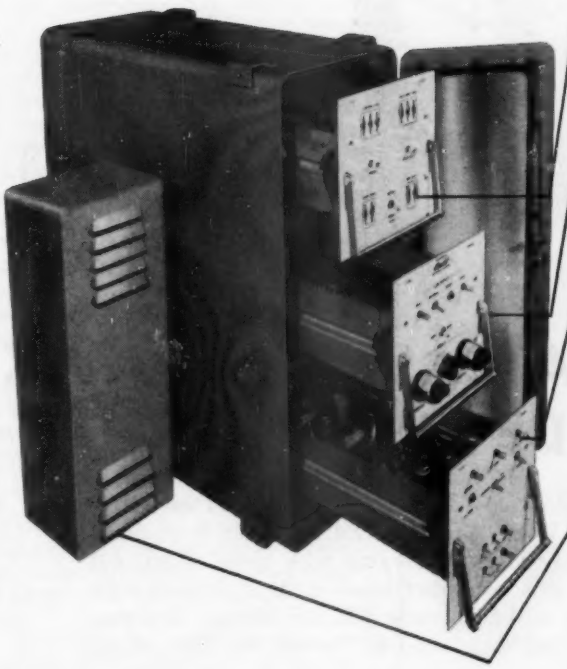
control certifies weld production costs

A resistance welding control that automatically compensates for every process variable



VOLTAGE CONSTRAINT

Graph shows how voltage control compensates for process variations. Any point on curved line E = IR represents a specific voltage. With normal weld as reference point, certain process variations cause increased resistance, while others cause a decrease. Control action is achieved through change of current to constrain voltage to same level for every weld.



SEQUENCE MODULE—Utilizes digital pulse-type circuitry . . . provides 100% accuracy.

HEAT CONTROL MODULE—Contains automatic and manual heat controls plus lockout devices. Processes input information from weld.

POWER SUPPLY MODULE—Power supply plus required auxiliary safety features.

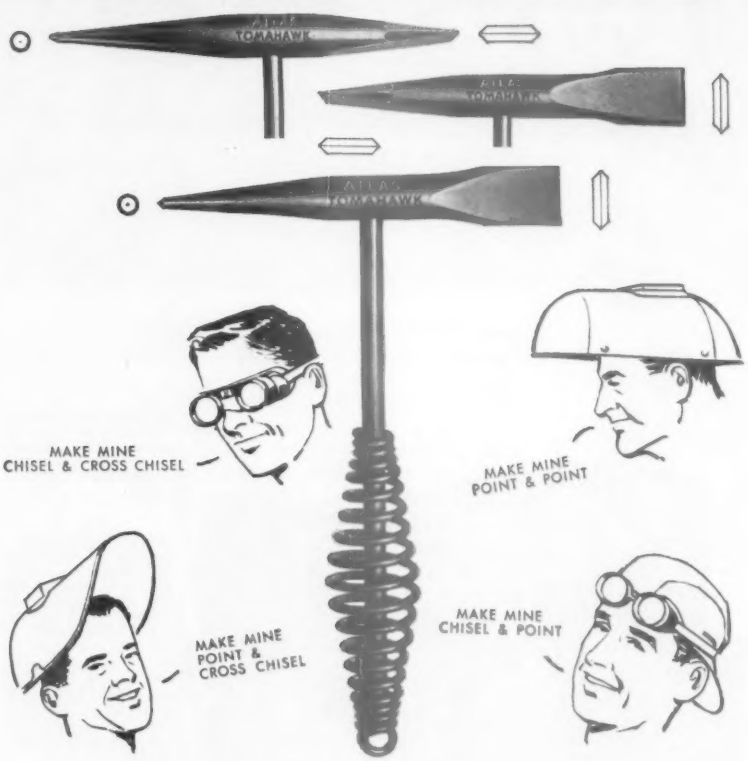
FIRING MODULE—Provides large currents needed to fire ignitrons. Supplied as separate module.

for complete details contact: THE BUDD COMPANY • Electronic Controls Section • Philadelphia 32, Pa.

ELECTRONIC Budd CONTROLS

ATLAS | WIDE - BLADE TOMAHAWKS

WORLDS LEADING WELD CLEANING TOOLS



***all-metal* ATLAS TOMAHAWK**
has* "WIDE BLADE", *too!

They all agree—They get anything and everything they want in an ATLAS TOMAHAWK: Burn-proof, break-proof, shock-proof grip with metal shaft, balance, feel and turn-proof head in the style they want. This is the tool that made ATLAS famous. Everyone likes it—even the man who spends his day on one end of it!

Tough as they come!

33 MODELS

Each Atlas tool is made as well as we know how. Ask your welding supply dealer to show you the complete line.

ATLAS
WELDING ACCESSORIES
INCORPORATED
707 E. LEWISTON
FERNDALE 20, MICH.

Letters . . .

Welding in the Sixties

Sir: *Troy, Ohio*

Regarding your special issue on the Soaring Sixties, we are entering the next ten years of welding, which has already grown to a one billion dollar business, on an ever-expanding scale. During the past 10 years, new machines, electrodes and processes have been developed and each seems to have its own special application.

In addition to the d-c rotating type welder, we have the transformer, the rectifier, the Tig machine, the constant-voltage and the constant-ampere machine.

We have the iron-powder electrodes, low-hydrogen electrodes — and now automatic welding coming to the front, with no electrode at all, just a small wire fed in automatically at a rapid rate under constant voltage with shielding of either flux, if the outfit is to be entirely automatic, or gas if the operator is to see what he is doing. During the 60's we expect more and more of this type of welding to be used. It is fast—no stub ends to throw away—and while it sometimes requires expensive fixtures to be made, it follows the trend of automation and will be in greater use during the period ahead.

Welding is tied closely to the steel industry—a basic industry. As steel goes, so does welding and the steel production of this country is the largest in the world. While the steel strike has dealt a setback to the fabrication of steel, this, we think, is only temporary and will in no way slow up the welding industry which will become bigger as steel products grow.

We are in the age of automation and we believe that the future holds much for welding in this direction. More and more welding will be done automatically with the wire fed from rolls, either flux or gas shielded.

These new techniques and new processes all require instruction and teaching, not only of the individual weldor but also of customers and salesmen and to this end, we have built and are operating a technical school for instruction of weldors, customers and salesmen. Our slogan is no longer "simplified welding;" it now becomes quite technical.

We are optimistic about the future of welding from the standpoint of its growth—not quite so optimistic, however, from the standpoint of profit possibilities, for frankly, the welding industry is getting too small a profit margin for the work and effort being put into it.

E. A. Hobart
Hobart Brothers Co.

Overseas request

Sir: *Zagreb, Yugoslavia*

Our Polytechnic Institute for Production Engineers is in need of professional technical literature for instruction purposes as well as for scientific documentation.

We kindly ask to send us a specimen of your journal dealing with welding.

Looking forward to your kind reply and thanking you in advance, we remain, sincerely yours.

Prof. Drago Kunstelj
Polytechnic Institute

Salt water cutter

Sir: *Columbus*

In your December issue, the Weld-World page contained a paragraph about a new process under development which utilizes electrified salt water for metal cutting.

We would like to receive more information on this process. If possible we would like the name and address of the company or parties who are developing this method of cutting.

R. E. Rugh
W. C. Delille Co.

Sir: *Downey, Calif.*

Please send the name of the company working on metal cutting with electrified salt water, referred to in page 5 of the December issue.

Samuel Young, Jr.
North American Aviation, Inc.

—The Anocut Engineering Co., 631 Washington Blvd., Chicago, Ill., Lynn A. Williams, president, is the firm involved in the development of the process.

"Weldor" vs. "Welder"

Sir: *Troy, Ohio*

Lately we have been having considerable discussion concerning the use of the words "weldor," "welder," and "welding operator."

Through the years, Hobart has been using the word weldor in correspondence, literature and our advertising. We had used the word welder to designate the welding machines.

Recently we had occasion to use the word weldor in connection with ASME code qualification work. We were severely criticized by people actively concerned with qualification work and specification. This criticism was based on the fact that weldor is not recognized by the ASME definition nor the AWS definition. They contend that welding qualification test sheets and approved welding procedures are involved in legal contracts and must, therefore, abide by the legal definition.

Frankly, we like the terminology weldor designating the man and welder designating the machine. [But] in view of the legal requirements in such instances, we feel that we should use the words as defined by the societies. We are willing, however, to lend assistance to you or to take necessary steps to try to have the word weldor accepted as the legal word for the man who welds.

Howard B. Cary
Hobart Bros. Technical School

—Weldor is an acceptable word in Webster's dictionary, and we are sure it will be picked up by others. WE has used the term for 20 years, giving it widespread acceptance, and under such circumstances we feel that eventually AWS and ASME will have to change their positions.

Welding's future

Sir: *Oakland, Calif.*

It's easy and obvious to predict the brightest era in the welding industry's brief history for the decade ahead. Welding is now an accepted major process for joining metals. More metals will be joined between now and 1970 than ever before. Obviously, the welding industry in general can look forward to a corresponding increase in usage.

While this is a safe prediction for the welding industry in general, it is certainly no guarantee that everyone engaged in the industry will prosper. Only those who keep pace with the tremendous—almost frightening—demand for new and improved methods and equipment can hope to stay in the race.

Manufacturers and fabricators using "common" metals look to us in the welding industry for methods and equipment that will improve quality, increase production and reduce costs.

Producers of "space age" products in the aircraft, missile and nuclear fields look to us for production welding processes and equipment to handle metals and alloys that were mere laboratory experiments a few years ago.

As never before, the ten years ahead will be an age of specialized research and development in welding processes and equipment . . .

The full benefits of these processes can only be realized when power supply characteristics are properly matched to the specific power requirements of the process. Much research has already been done to determine exactly what these requirements are, and we are learning more every day . . .

G. G. Glenn
Glenn Pacific Power Supply Corp.

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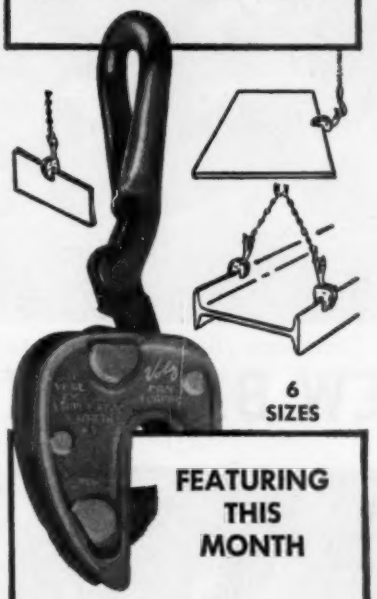

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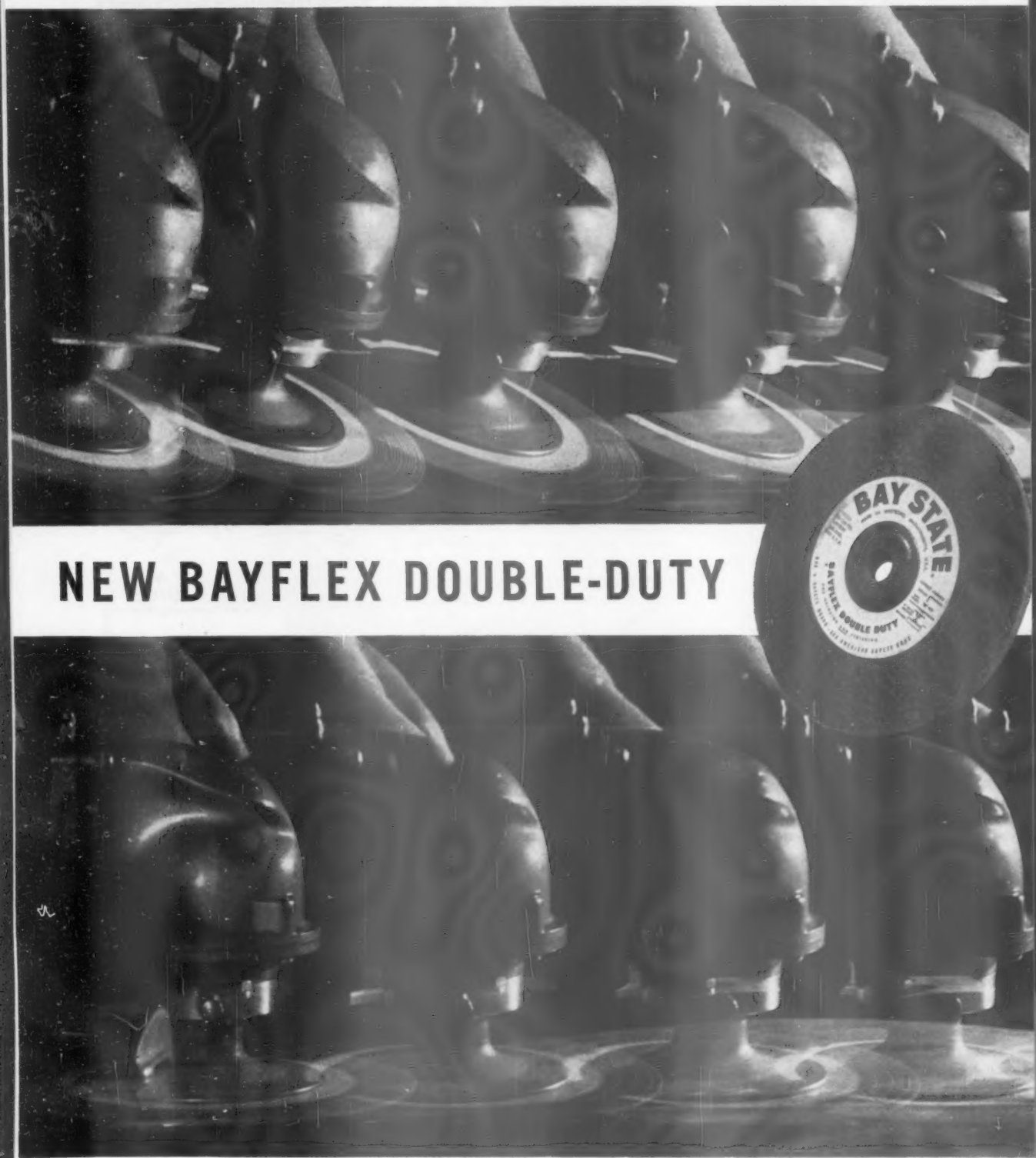


NEW BAYFLEX DOUBLE-DUTY

Illustrations above show Bayflex Double-Duty in action, held at correct angle for weld bead grinding (top) and for finishing (bottom)

WITHOUT CHANGING WHEELS!

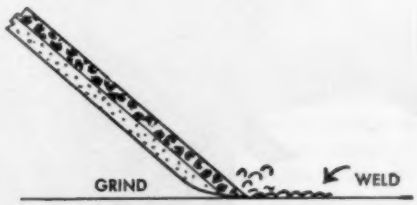
IS 2 WHEELS IN 1

There are two important angles to consider before you buy new weld-grinding or finishing wheels. Bay State's new Bayflex Double-Duty raised hub disc-wheel has them *both!*

The "DD's" unique, two-layer construction gives you two grinding angles: One is 30° - 45° which gives you fast stock removal for grinding weld beads . . . and the other is 10° - 20° which gives you a finish without gouging, a finish so smooth it's just short of a polished surface.

The upper layer for weld grinding comes in a single, standard specification. The lower finishing or blending layer comes in your choice of five different grits (24, 36, 54, 80 and 120) for every type of finishing job from heavy steels through light stainless sheets to aluminum and copper.

Your Bay State representative is ready now to demonstrate the Bayflex Double-Duty in your plant under normal working conditions. Get in touch with him and see what he can do to cut costs and speed up your weld grinding. You'll find he's more than a good salesman . . . because he's an experienced abrasive specialist, too. *Better grinding at lower cost . . . that is his business.*



Upper layer removes stock rapidly when disc is held at 30° - 45° angle.

Lower layer smooths and blends surface when held at 10° - 20° angle.

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Bay State Abrasive Products Co., Westboro, Mass.
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AND BOTH MILLERS ... *Through and Through*

BIG TWIN combination ac-dc welders work from single phase service — deliver new convenience and economy. Two a-c amperage ranges of 20-125 and 60-290 plus two d-c ranges of 18-100 and 65-290 amps master nearly every welding requirement from light gauge metal to structural pieces. Movable shunt type transformer affords infinite current adjustments. Other features include: Horizontal design for easy stacking; weather-resistant construction and Class B insulation; Miller-built semi-metallic rectifier for best d-c welding; high open circuit voltages and new weld stabilizer. This is THE all-time, all-around welder!

LITTLE TWIN ac-dc combination welder has two a-c amperage ranges of 20-115 and 60-180 plus one d-c range of 40-150. Operating from single phase service, this Miller model incorporates many design and construction features usually found only in large industrial types. These include really rugged construction, forced air cooling, new Miller semi-metallic rectifier, movable shunt type current control, new weld stabilizer and open circuit voltage in abundance. Power factor correction is available on both models. Complete specifications on either model will be sent promptly upon request.

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BETWEEN PASSES

note of optimism

Now that the steel strike is over, most of the predictions for the coming year and decade published by *WE* last month seem to be on solid ground. (For two more views on the "Soaring Sixties," see the "Letters . . ." column.)

A statement by Secretary of Commerce F. H. Mueller after the strike settlement contained the forecast that " . . . the overall economy, already at record peak, should bound forward to make 1960 the most prosperous year in our history. The gross national product, currently at an annual rate of around $480 billion, should move steadily forward the half trillion dollar figure by summer."

Rickover on welding

Not one to mince his words, Vice Admiral Hyman G. Rickover, the Navy's controversial top man in its nuclear program, recently complained about the inadequate standards and specifications that are hampering the rate of the Navy's conversion to nuclear propulsion.

Speaking in December before the National Conference on Application of Electrical Insulation, Rickover listed many of the deficiencies uncovered during the 10 years he has had to work with industrial codes, inspection techniques, etc., while building nuclear power plants.

Among the specific examples he cited was welding. Rickover said:

"Good welding and good inspection techniques are essential to the building of our nuclear power plants. We have found it necessary to write our own complete standards for welding and weld inspection to remedy the following specific problems encountered in the use of existing standards:

"*A*—The requirements for the type of electrodes and the heat treatment used during welding of stainless steel were inadequate to prevent cracking of such welds.

"*B*—The requirements for radiography of various weld configurations were based on what could readily be achieved rather than on what was necessary to detect harmful defects.

"*C*—There were no requirements as to when inspections of welds should be performed. As a result, it was possible for a manufacturer to inspect a weld, find it acceptable, and than damage the weld during subsequent fabrication. There were no requirements for subsequent inspection to prevent these welds from being placed into service.

"*D*—In many cases, radiographs taken at a manufacturer's plant and the spot check radiographs taken after delivery of the equipment—both of which were taken in accordance with the same standard—gave different results. In one case, the welds were acceptable; in the other case they were not. This very clearly showed us the inadequacy of present radiographic standards."

Rickover, after citing more examples in areas other than welding, went on to say that he believed one of the reasons for "the present poor standards and specifications is that they are prepared by groups of people who represent the *manufacturers'* viewpoint rather than the *users'* viewpoint. The manufacturers . . . will invariably agree on a standard that is least restrictive to them. The user . . . is generally not sufficiently familiar with characteristics of the materials to require a better standard."

He suggested that technical committees preparing such standards "be composed primarily of *users* rather than *manufacturers*. The latter . . . must take on the responsibility to insure that only fully qualified individuals represent them on these committees. Furthermore, these individuals must consider their prime objective . . . specifications which will produce a high-caliber product, rather than agree on mediocre specifications which all interested companies can meet."

report from Europe

Strong differences in the European welding market compared with U. S. operations were noted by Donald W. Smith of The Sight Feed Generator Co., upon his return from abroad. The chief engineer of the West Alexandria, Ohio, firm spent two months in North Africa and Europe.

Smith said, "The European industry has ways of doing things differently from ours because conditions are different—in the geographical size of the market, the size and type of the industries, the difficulty of doing business across political boundaries, and methods of transport. As these conditions change to more closely resemble ours, it will be profitable and necessary to adopt modifications of our ways."

An example cited by Smith was the fact that little compressed gas is distributed by rail in the U. S., while in Europe many cylinders must be so shipped because roads have not developed fast enough for truck transportation to spread out from city areas like it has here.

"Also, electrodes are sold in smaller cartons and by count instead of by weight," he added. "This is because there aren't as many large users to demand it. Then, too, the price of electrodes is higher in comparison to the price of one hour of labor in the U. S."

Smith noted that there isn't as much hardfacing in Europe as in this country—largely because there aren't any vast mechanized mining operations, steel mills are smaller, and earthmoving industry is also not of comparable size to that in the States.

Primary purpose of Smith's trip was to train personnel of the Caterpillar dealership in Algiers—Compagnie Algerienne de Tracteurs—in the use of Rexarc equipment for rebuilding tractor rails, rollers and idlers. (At press time, Sight Feed changed its name to Rexarc, Inc.)

Stop pumping welder maintenance money into a leaky bucket!

When your welder reaches the age where partial repairs occur too frequently and the usefulness of the machine is continually interrupted—it's time for Lincolnditioning.

Lincolnditioning is complete remanufacturing. Your welder, returned to the factory, is completely torn down and rebuilt, so that all the parts are returned to new-machine condition or replaced when necessary. You know how much it will cost before you start. You have it done when *you* want, not when the machine breaks down. You receive a NEW WELDER GUARANTEE.

Compare the advantages of LINCOLN REMANUFACTURING *with Fix-as-you-go maintenance*

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A Lincolnditioning job on your welder is like buying a new, guaranteed machine for about ⅓ the original cost!

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FEBRUARY, 1960

Welding Engineer

ESTABLISHED 1916

The leading lady

IN TWO SHORT MONTHS, one of the bigger celebrities gadding about the Los Angeles area will be the welding industry, once a bit player but now playing a leading role in America's industrial pageant.

Press agentry aside, April this year will not only be "National Welded Products Month," but also the time for the eighth annual welding show. We are indeed happy that the American Welding Society is continuing these two activities first advocated by WELDING ENGINEER.

When recommended slightly over 15 years ago, the idea of a separate welding show was somewhat of a dream. But *WE* rightly predicted the future. Now the show has exceeded our fondest expectations and has become one of the nation's 25 largest industrial shows.

However, it has also become too big to accomplish some of the things we desire; too big to go into the smaller industrial areas to further acquaint people with the importance of welding.

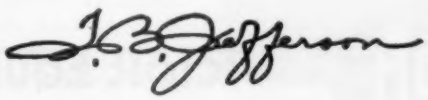
This is where National Welded Products Month "makes the scene," affording a means of selling welding—and selling it hard!

Although initiated by *WE* and now sponsored by AWS, actual sponsorship rests in the hands of all who work with welding. It is at the individual level that welding's story can best be told—and there is much to tell.

If we are to accomplish all the things we want for welding, we must make its promotion a year-round project, not just during April. The more people we make welding-conscious, the more use welding will realize.

Many of you who cannot make the trip to the west coast will keep posted on the show and other activities through WELDING ENGINEER. But all of us can take advantage of National Welded Products Month by acquainting our friends and neighbors with welding's importance in their everyday lives.

It's our job to tell—and sell—the uninitiated. We can all be welding "press agents."



Preheating carbon-moly tubing with Victor Model J27 torch and Type 28 heating nozzle at Besler Corp., Emeryville, Calif.

The man on the job likes Victor torch flexibility

Flexibility is built into all Victor torches, regardless of size. Here, for example, Series J torches are being used to preheat, then weld 5/8" O.D. with .095" wall tubing for steam generators. With a change of nozzles and tips these same torches braze and solder . . . with the addition of a cutting attachment, can be used for light cutting applications and ocasional short jobs up to approximately 2" steel.

Victor Series 100 torches for medium-duty work and the famous Series 300 for tough, heavy work, give you this same flexibility . . . heating, welding, brazing, soldering, cutting. All 3 sizes, with proper cutting attachment, can be used with oxygen-acetylene, oxygen-propane, oxygen-city or natural gas.

Ask your Victor dealer for a demonstration now. You'll see for yourself how Victor torches answer all your welding and cutting needs.

Welding 5/8" O.D. with .095" wall tube into generator coil, using Model J27 torch and Type 17 welding nozzle with oxy-acetylene.

Profitable dealerships open in a few areas; inquire now.

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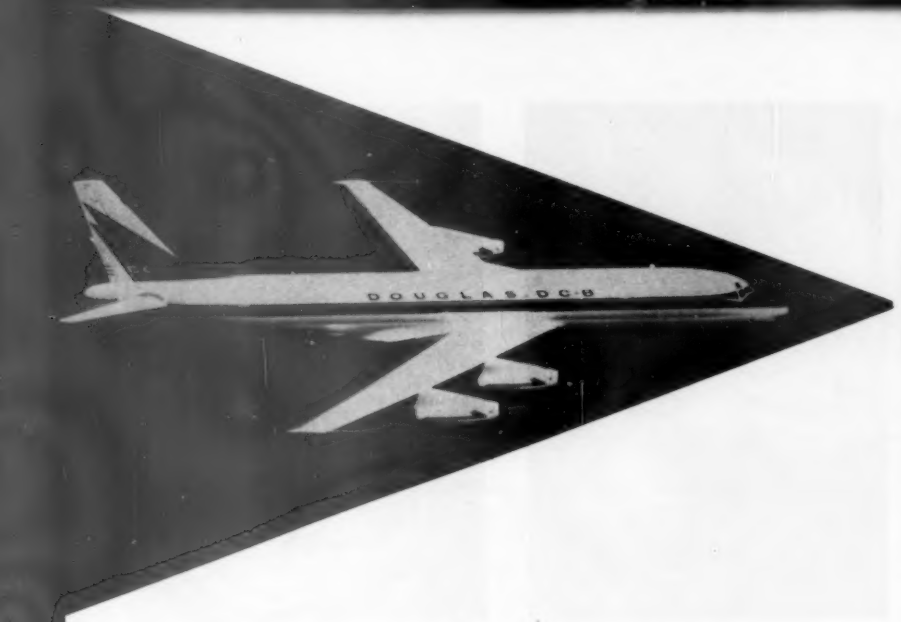
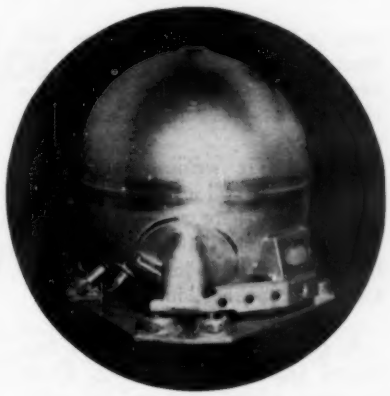




by **J. P. Green**
Linde Co.

Compact, lightweight, and strong . . .

Tig welded liquid oxygen converters take over for high-altitude breathing

CIVIL AVIATION has generally followed the pioneering paths provided by military aviation.

And since personnel in advanced jet fighters and bombers are relying on liquid oxygen in lightweight containers for breathing oxygen, it won't be long before high-altitude commercial jets will also be relying on the same system for use in emergencies.

This method of supplying oxygen during high-altitude flights is a result of a quiet revolution from the use of gaseous oxygen in cylinders.

With the old method, the average bomber carried 625 cu ft of cylinder oxygen totalling 269 lb and occupying 47 cu ft of valuable space. The same amount in liquid form can be carried in an 89 lb converter occupying only 7.9 cu ft.

The most important converter requirements are lightweight construction and the ability to withstand high buildup pressures.

By using special insulation and leak-testing techniques, Linde Co. guarantees a reliability never before possible. For example, vacuum insulation, necessary to keep heat from reaching the extremely volatile liquid, is guaranteed for a year rather than the usual 90 days.

Converters are fabricated at the firm's Speedway plant, Indianapolis, in a section known as the "white coat" area. The white coats and overalls are part of the rigid quality control program, *e.g.*, air-conditioning, strict "no smoking" rules, clean white gloves in most assembly and production steps.

The 25-liter converter is a sphere (304 18-8 stainless steel, 0.062 in. thick) within a sphere (0.091-in.-thick 5154 aluminum). Both arrive at the plant pressed in half spheres.

Girth welds on both are automatically Tig welded on one fixture. For the stainless inner lining, current is 185 amp, d-c straight polarity, 10½ volts, 18¼ ipm; for the aluminum sphere, 170 amp, a-c, 14 volts, same welding speed. Inert-gas flow for both is 25 cfh, using a tapered 3/16-in. electrode.

Running from top to bottom in the inner sphere is the "probe" or con-

GIRTH seam on aluminum outer sphere is automatically Tig welded. The same welder is used on the stainless steel inner sphere.

tents indicator. Insulated wires lead from the probe top out through the vent tube and are connected in a circuit that measures contents by capacitance.

Manual Tig welding is used to join vent and fill outlets to the inner sphere. There are 15 welds in the stainless steel totalling 60 lineal in., and 16 welds in the aluminum totalling 205 lineal in.

A converter also requires two brazed joints in the tubing. From the inner sphere, vent and fill tubes are stainless steel until they reach the aluminum outer sphere. There a braze-weld between the dissimilar metals is required.

Girth welds on both spheres are X-rayed, examination of the inner one prior to placement into the outer sphere, which is examined before the legs are welded.

Legs and most components for assembly are stored in polyethylene bags which are opened just prior to use at the assembly station. After wire-brushing, the legs are Tig welded using a-c, 185 amp, 14 volts with an argon flow of 25 cfh and a ER5154 filler rod.

The converters are then ready for strength and leak tests. A pressure test of the outer sphere is made by placing the unit in a steel tank, applying pressure to the inner sphere so it will not collapse, and then putting 250 lb pressure into the vacuum space. Test pressure is far above the bursting disk pressure of 110 lb. Pressure testing of external piping is done at 320 lb.

LEGS for the outer sphere are removed from polyethylene storage bags at assembly station just before welding.

BOTH the outer aluminum and the inner stainless spheres are X-rayed in five positions to get a complete picture.

A mass spectrometer tests for possible leaks in the inner sphere, as well as the vacuum space. Converters are placed in polyethylene bags into which low pressure helium is piped. A vacuum is pulled on the annular space and any leaks in either sphere will pass helium. The spectrometer will register one part helium in 10 million parts of air.

Insulating material is then added by drawing a slight vacuum on the annular space in the cylinder and injecting the proper amount. The vacuum is pumped to a pressure of 5 microns by placing the converters in electric ovens and hooking them to vacuum pumps. The converters are brought up to 290 F and pumping continues for 72 hours.

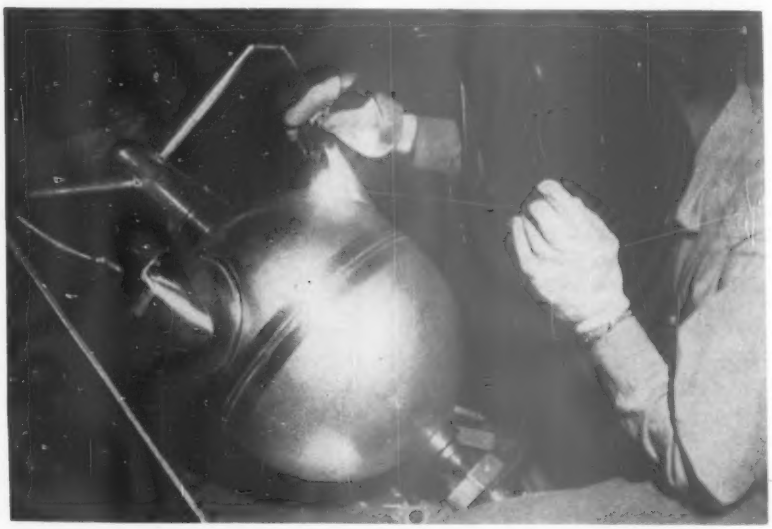
For the evaporation test, the unit is filled with liquid oxygen and placed on a scale. A weight-loss reading determines if evaporation loss is 4 lb or less in 24 hours. A second similar test is made 30 days later, at which time evaporation must not exceed 0.4 lb above the first test, and never more than 4 lb.

The passed units are then ready for cable wrapping (to prevent cylinder disintegration if stuck by shells or bullets), painting, name plates and final assembly.

The cable-wrapped converter undergoes final tests which determine delivery capacity and contents-indicator accuracy. As contents are drawn off, pressure must remain between 295 and 315 psi.

One of every 150 units is tested on a 2,000 cycle-per-second vibrator. A temperature chamber with a 450 to —100 F range is mounted on the vibrator to hold the converter. Filled units are tested from 260 to —65 F. Normal delivery must be maintained at all times.

Space age developments are definitely going to require the most compact and lightweight systems possible. And these converters seem to have a bright future.



USING a ER5154 filler rod, welder joins converter legs to aluminum outer sphere whose girth weld was X-rayed prior to welding.

Important facts about industrial adhesives

Glues of all types are being used to cut costs in many operations. So that you may be able to find some use for them, here are . . .

RECENT DEVELOPMENT of new materials and methods now make it possible to economically fasten structural materials by means of adhesives.

Most adhesives fall into three categories. There are soluble polymers such as animal glue, starches and dextrins, sodium silicate, polyvinyl, alcohol, etc., which are activated by water or some other solvent.

Another group of adhesives are thermoplastic resins and elastomers, including natural resins, pitches, polyvinyl acetate, waxes and unvulcanized elastomers.

The third group is thermosetting of chemically setting resins and elastomers. These include phenolics, furans and vulcanizable elastomer compounds. These become resistant to heat and solvents as a result of an irreversible chemical change.

There are many processes which lead to hardening or to the formation of an adhesive bond. First is the diffusion of solvent into the adherend (work-pieces to be joined by means of adhesive) accompanied or followed by evaporation. The setting of glued wood joints is an example. Solvent-activated adhesives cannot be used unless the adherends will let the solvent soak in.

Second is pressure applied to a tacky, slightly plastic film, as in attaching pressure-sensitive tape.

Third is the cooling of a thermoplastic material which has been softened by heat, a process well adapted to high-speed machine operation.

Fourth is the irreversible chemical set, in which polymerization or condensation takes place (hot or cold) with or without a catylast. Resistance to heat, moisture and solvents is characteristic of this adhesvie bond.

Satisfactory performance of an adhesive assembly is often the result of trial-and-error matching of adhesive to adherend. Naturally, you must have due regard for a number of relevant properties.

First to be considered is the specific adhesion. Basically this means: certain combinations perform well almost always, others never do. Raw or unvulcanized rubber, for example, adheres to steel poorly or not at all, but rubber vulcanized in contact with brass-plated steel cannot be peeled off without tearing.

Identical materials can nearly always be joined successfully under pressure if softened by heat or solvents. This method, when applicable, is the preferred way of joining thermoplastics.

The setting of animal glue and other solvent activated adhesives is accompanied by solvent loss and shrinkage. Therefore, the stresses set up by this process in a heavy film of rigid material may weaken or destroy the bond. The strongest animal-glue joints are moderately thin. However, the more resilient materials seem little affected by film thickness.

Other stresses to be provided for are caused by thermal expansion, absorption of moisture, and mechanical loading. Usually it is best to select an adhesive which most nearly matches both adherends with respect to cohesion and resilience.

Cold-flow or creep under long-continued stress may cause the failure of joints cemented with thermoplastics. This sometimes precludes their use as structural adhesives.

The special conditions of fabrication and use determine the adhesive selected. Conditions include: time and temperature required for bonding; cost of shelf life; such properties as color, odor and toxicity; and resistance to heat, cold, moisture, solvents, sunlight, mildew and chemical attack.

Requirements for economical performance when joining metals appear in a number of special situations. Among these are jobs in which the adhesion of the joint must approach the strength of the members joined, or must greatly exceed the maximum working stress. Typical examples are butt and T-joints in honeycomb structures or lap joints in sheet metal.

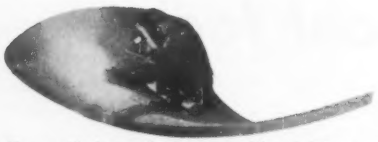
Two common types of metal adhesives—structural and non-structural—correspond to two levels of performance. In practice, the thermoplastics have been found liable to cold flow or creep, with uncertain adhesion under long-continued stress and—for some purposes—insufficient resistance to extreme temperatures.

Polyvinyl acetate, polyvinyl acetals and some of the acrylics nevertheless adhere well to metals and many other materials, for example, 2,500 psi in shear on steel. Hence, their non-structural use is the most common.

Thermosetting adhesives are chiefly phenolics, epoxies and blends, but include furan and others. They are preferred for structures exposed to continuous or alternating stress, extremes of temperature, or conditions in which uniformly high strength is vital. Most blended materials are based on phenolics and/or epoxies with additives comprising vinyls, nylon and synthetic rubbers.

The large variety of such materials provides for a range of curing conditions—right down to the light contact pressure attainable by wrapping with string. It reflects especially the need for adhesives which will not only stick fast to the materials joined, but will also match their mechanical properties well enough to avoid destructive stresses at the glue line.

Surface condition, of course, is important. Metals require degreasing, and usually anodic or chromic acid treatment. In some cases an intermediate film is deposited. Vulcanized rubber surfaces are often cyclized but molded plastics are usually only cleaned.



Cover photograph shows weldor joining solid stainless steel insert to mild steel vane in pump-turbine runner.

The second award paper in the Lincoln Foundation's annual machine design award program shows . . .

Many advantages gained when redesigning turbine runners for welded fabrication

by **Fritz M. Hessemer**
Allis-Chalmers Mfg. Co.
York, Pa.

THE MOST IMPORTANT part of a power-generating hydraulic turbine is the rotating runner which converts water's potential energy into useful power.

In the past 70 years, these runners have grown in generating capacity and size from a few hundred horsepower and several feet in diameter to 170,000 hp and 20 ft diameters. Their weights have exceeded 70 tons.

Because there was no other manufacturing process available in the early days of the hydromachinery industry, casting was used. And this process has been keeping pace with the runner's increasing size.

However, with these increases have come increased problems when buying one-piece cast runners.

(1) Very few foundries have adequate facilities to handle these large runners. As a result, when many turbines are being built, deliveries are late.

(2) Casting quality is not uniform. Cracks and other uncontrollable defects always require much rework either at the foundry or shop, causing further delays.

(3) Casting dimensions are frequently beyond allowable limits, resulting in rework and occasional scraping. In particular, the opening between each pair of buckets (the vent through which water flows) must be uniform and of a specified total area. This is frequently not within tolerance due to misaligned cores, variable shrinkage or other uncontrollable factors.

(4) Casting price per pound has risen rapidly.

(5) Uneven thicknesses of the casting sections make static and dynamic balancing difficult.

These five problems have made it difficult for turbine builders to maintain proper control over runners, necessitating a different manufacturing method. Welding crowns, buckets and band into a single unit was the only solution.

By changing the manufacturing technique to welding, the following advantages resulted:

(1) Reduced material cost. The pound price of smaller cast components is about two-thirds that of a solid cast runner. The band could be made of plate steel at about one-fifth the cast price.

(2) Better control of critical dimensions. Each component is a simpler casting, making dimensional adjustment possible during fabrication.

(3) Less total weight. The solid cast process required operationally useless metal to be put where needed for the casting process. Welding would put metal where needed from a good design standpoint.

(4) Better quality. The weld metal can be closely controlled. Defects in solid cast runners were usually found in those areas where welds would be placed.

(5) Improved scheduling control. The small components can be bought from many different foundries.

(6) Increase in labor overhead absorption. The additional welding hours would be concentrated in a small area with very little additional indirect costs.

(7) More uniform weight distribution. By weighing each bucket and locating it selectively, difference in bucket weight could be adjusted for better balance.

(8) Better appearance. It would be much easier to surface grind individual buckets before assembly than to grind on highly inaccessible solid castings.

Fourteen large runners have been so welded and there are seven pump-turbine runners now being built.

TURBINE runner is readied for shipment on specially designed flatcar after all welding has been completed.

The latter have an additional design feature which is a further refinement of the cast-weld method.

Runner areas are sometimes overlaid with stainless steel to reduce cavitation-erosion. These areas are then ground and polished to remove all weld ripples.

The overlaid areas do not hold shape because all welding is on one side and frequently expensive bracing or flame-straightening is required.

A study of costs, however, indicated that welding a solid-cast stainless insert, shaped like the overlaid area, to the mild steel bucket would reduce welding costs, shorten manufacturing cycle, maintain vane contour and reduce grinding costs. About 12 sq ft of area on each of six vanes is stainless steel.

For all fabricated runners, the separately cast crown and buckets were of ASTM-A27 (65-35), an easily welded mild steel, and the rolled plate bands were ASTM-A201, Grade A, Firebox.

Bevels for the crown-to-bucket joint were 60 deg double Vee and for the band-to-bucket joint, 45 deg double bevels with $\frac{3}{4}$-in. radius fillet. Weld roots were removed by deseaming torch or arc-air, and ground to bright metal before rewelding specified through-welds.

The first several passes were made with E7018 electrodes followed by manual submerged-arc welding when possible. Also used were $\frac{1}{4}$ and $\frac{5}{16}$-in. diameter E6020 electrodes. For the mild steel to stainless welds on the pump-turbine runner, E309-16 stainless was used.

The buckets were set and tack welded on the premachined crown, using fixtures and jigs to carefully check the vents. The braced crown and bucket assembly were mounted on a spindle supported on turning rolls and then finish welded.

Porosity, penetration and slag inclusion at the discharge end of the weld were checked, since this is an area where defects in solid castings appear after several years of operation.

The premachined band was then fitted around the contour trimmed bucket edges and welded. After stress relieving with an 8 hour soaking period, the braces were removed and the runner shipped to the machine shop where it was considered as a one-piece casting.

The expected cost savings in manufacturing were exceeded by a fairly large amount, and dimensions of critical water passage of the cast-weld runners were closer

WELDOR fills joint between crown and bucket using manual submerged-arc welding process.

ASSEMBLER checks the vent through which water flows between buckets on partially set-up runner.

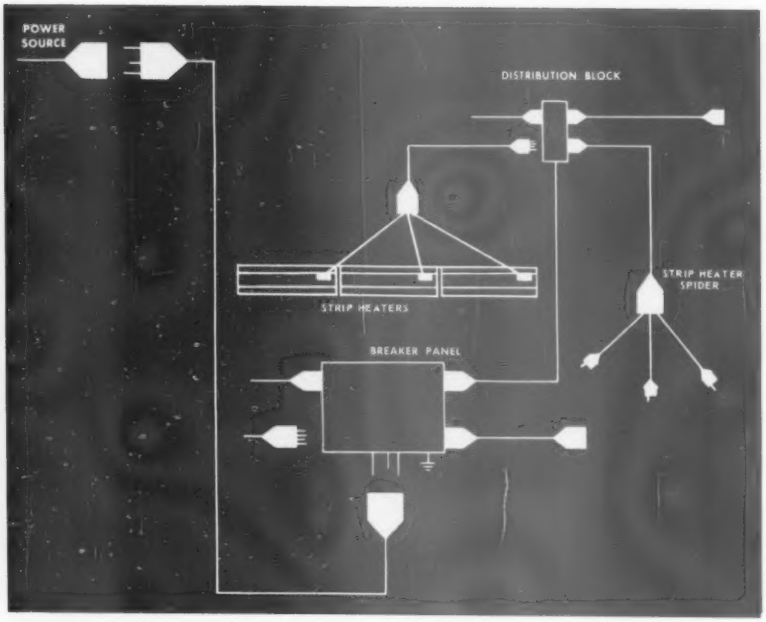
to theoretical hydraulic designs than most solid-cast runners.

Field test reports of turbine efficiencies, lack of vibration and horsepower generated are all better than guaranteed. Customers, in whose plants 9 of the 14 runners are in operation, are well pleased. The remaining five are being installed in South America but are not in operation yet.

No cast components were rejected, so that production scheduling was simple and planned schedules were met successfully. The difference in total labor hours between the two methods resulted in a large burden absorption which would not have occurred with cast runners.

On the basis of this experience with the 14 runners built, and anticipated savings on the seven pump-turbine runners now being manufactured, the company feels it made a wise decision to change to welding.

BAND to bucket joints are 45 deg double beveled with $\frac{3}{4}$-in. radius fillet. E7018 and E6020 electrodes were used.



SCHEMATIC shows how strip heater units in varying numbers and locations, depending on size and shape of weldment, are connected to a power source through breaker panel for automatic overload protection.

A guide to preheat

"IF WELDING is accomplished without benefit of preheat, the fabricator is, in effect, getting away with something."

This statement is more academic than practical since a vast bulk of low and medium carbon steels is satisfactorily welded every day without preheat, and the resulting welds are entirely adequate.

This article does not advocate preheating "across the board" where benefits derived would, at best, be uncertain. It will, however, answer some basic questions about preheat, where and why it is used, and explain some of its benefits.

To meet today's extraordinary requirements, scientists have developed many new metals, and others have learned to join them into useable forms. Thus, new fabrication processes and techniques, as well as extensions of established processes, have evolved. Foremost among the latter is arc welding.

Since World War II, several welding methods have employed entire new families of electrodes. Important among these electrodes are the various low-hydrogen mild steel, and low-hydrogen low-alloy high-tensile ones used to weld so-called "problem" steels.

A low-hydrogen electrode minimizes moisture entering a weld, and hence, the amount of hydrogen. Hydrogen entering a weld through the arc will enter in its atomic form, and as the weld cools, will recombine into its molecular form.

This recombination exerts a tremendous pressure within the weldment, enough frequently to cause a rupture, or underbead cracking. The low-alloy, high-tensile steels are especially susceptible.

It follows then that when a welding application requires a low-hydrogen electrode, best results are obtained if moisture is eliminated or minimized in the baseplate just as electrodes are customarily oven-heated to keep them dry.

In many applications, plate area adjacent to the weld must be kept moisture-free by preheat if acceptable results are to be obtained.

Hydrogen can produce other undesirable effects in a weld area. Combined with other elements (carbon, selenium) it will produce a porosity-causing compound. Still another effect is weld structure embrittlement, which reduces ductility and lowers impact strength.

Thus, elimination or limitation of hydrogen in the fabrication of alloy steels is one important reason for use of preheat.

The preheat used, in terms of temperature, will vary depending on material composition, but in most cases is held near or above water's boiling point, or about 225 F.

Preheating is basically a means of raising the temperature of a material, metal or alloy to some desired level above the surrounding ambient temperature prior to welding and may involve temperatures ranging between 100 and 1,200 F, depending on application.

However, for practical reasons, it is usually applied in the lower ranges between 125 and 400 F. (By contrast, postheating is usually conducted at the higher temperatures, 600 F and above.)

Properly applied, preheat will accomplish any one or a combination of the following:

(1) Reduce the differential in temperature between weld, heat-affected zone and base metal, helping to prevent weldment distortion and minimize shrinkage stresses and stress cracks in the weld zone.

(2) Reduce the cooling rate or quench of the weld zone. Cooling rate is a function of temperature gradient and thermal conductivity. Preheating reduces the gradient and thermal conduction, thus slowing the cooling rate. This, in turn, permits more time for metal transformation to a favorable crystalline structure minimizing hard zones and cracks.

(3) Reduces not only the incidence of hydrogen accumulation in a weld zone, but also, by reducing the cooling rate, promotes diffusion of residual hydrogen and other weld gasses. Thus, effectively minimizes underbead cracking, porosity and embrittlement

Recommended preheat for steel alloys

TYPE MATERIAL	A.I.S.I. DESIGNATION	TYPICAL ANALYSIS %	SUGGESTED PREHEAT° F	SUGGESTED POST HEAT °F	NOTATION
Carbon Steel					
Low	C1008-C1030	C 0.10-0.30 Mg. 0.25-1.50 SU 0.05 Max Phos 0.04 Max	150 - 200	None Required	Preheat 200° F. is recommended on heavy sections 2" or over.
Medium	C1035-C1055	C 0.30-0.60 Mg 0.60-1.70 Phos 0.040 Max SU o.050 Max	200 - 400	Post Heat 1100-1200°F	
High *	C1060-C1095	C 0.60-1.05 Mg 0.30-1.00 Phos 0.040 Max SU 0.050 Max	550 - 600	Post Heat 1200° F.	This steel is not easily welded by electric arc process.
* Over 0.50 carbon welding is not recommended.					
Low Alloy Steels					
MANGANESE SERIES	A1320, A1330 A1335, A1340 A1345	C 0.15-0.50 Mg 1.60-1.90 Phos 0.040 Max SU 0.050 Max SI 0.20-0.35	A1320 200-300 A1330 300-400 A1340 400-500	1100-1250 1100-1250 1100-1250	Low Hydrogen E 70 XX Electrodes are recommended
MOLYBDENUM SERIES					
A. Carbon	A4023-A4068	C 0.20-0.70 Mg 0.70-1.00 phos 0.04 Max. Su 0.035-0.05 Si 0.20-0.35 Mo 0.20-0.30	C. -020 -100-150 C. 030 - 200-300 C. 030up-350-450	1200°F See Notation	Stress Relieve @ 1200°F & hold 1 hour each inch plate thickness. Cool at 200°F/Hr. to Approx. 200°F.
B.Chrome	A4118-A4150	C 0.18-0.50 Mg 0.70-1.00 Cr 0.40-1.10 Mo 0.10-0.30 Phos. 0.04 Su 0.05 Si 0.20-0.35	A 4118 100-200 A 4130 300-400 A 4140 400-500	See Above	See Above
C.Nickel	A4320-A4820	C 0.15-0.20 Mg 0.40-0.80 Phos 0.04 Max Su 0.05 Max N. 1.50-3.75 Mo 0.20-0.40	A 4320 200-300 A4340 400-500 A 4620 100-200 A 4640 300-400	See Above	See Above
CHROME SERIES	A5015-A5160 E50100-E52100	C 0.15-1.10 Mg 0.30-1.00 Cr 0.20-1.60 Si 0.20-0.35 Phos 0.04 Max Su 0.05 Max	A5120 100-200 A5130 200-300 A5140 350-400	1200°F	
LOW ALLOY HIGH TENSILE STEELS	Corten Cromansil Manten Yoloy Otiscoloy	C .10-0.25 Mg 0.20-1.50 Phos 0.07-0.1 Si 0.10-0.30 Cu 0.25-0.55 Plus - Ni Zr Mo in various %	150 - 300		Preheat particularly recommended on higher C and heavy plate
	T-1*		150 - 200		
* T-1 is a quenched and tempered steel (Martensite) which will harden under excessive heat treatment.					
MARTENSITIC STAINLESS STEELS 12-18 Cr.	A400 Series Less 405,430 430F,446	C 0.10-0.20 Mn 1.00-1.25 Phos 0.04 Max Su 0.03 Max Cr 12-18.	350-500 °F	See Notation	Anneal 1450 1550° F soaking thoroughly then cool @ 50°F/Hour to 1200° Then Air Cool
4 - 6 Cr.	A501-A502	C 0.10 Mn 0.50 Phos 0.04 Max Su 0.04 Max Si 0.50 Cr 4.0-6.0	350-500°F	See Notation	Anneal and soak 1500-1550° F. Cool slowly as above

Preheat temperatures are average values. Actual values depend on material's chemical composition, thickness and restraint imposed on weldment by joint design and positioning. Generally, higher carbon content materials and thicker metal sections will require maximum values; higher temperatures to be used on material 2 in. or more, minimum temperatures for 1 in. or less.

in the weld and adjacent area.

When a metal is perfectly pure, at some temperature point it transforms from a liquid to a solid state, *viz.*, a pure metal will pass through a critical temperature point in going from liquid to solid.

Where two or more metals, each with a different melting point, are combined in solution to form an alloy, that alloy will pass through a critical temperature *range* when passing from liquid to solid.

Some metals (iron and nickel) have a great affinity and readily combine in solution to form a new metal. This combination will pass through a very narrow critical range. Other metals in combination have only a partial affinity for each other and are, therefore, only partially soluble. Hence, there is in solution a new alloy which freezes over a relatively wide temperature range.

When solidification occurs over such a range, a crystalline structure forms with the higher melting point elements freezing first and, as cooling progresses, the lower melting point elements going to solid. Thus, unless cooling is slow and controlled, large grain structure formation and segregation of elements is probable.

Formation and size of the grain structure, segregation or precipitation of alloying elements and its distribution within the alloy structure, all have great influence on physical properties with respect to ductility, tensile strength, corrosion resistance, impact properties and temperature transition.

Generally, the finer the grain structure, with little or no segregation, the better the ductility.

Thus, by slowing the cooling rate, preheat can and does exert an important beneficial effect on the alloy and its physical characteristics. There are, however, some other conditions.

In the solid state, all useful metals are crystalline in structure with crystals in more or less orderly arrangement with respect to each other. In pure metals, as it changes from liquid to solid, the crystalline structure grows in a definite pattern or lattice until solidification is complete. In an alloy the arrangement and structure is modified.

Crystals are composed of unit cells of orderly, geometric atom arrangements in three dimensional or cubic form. These unit cells are either "body-centered" or "face-centered."

A body-centered cube is a cell with atoms at each corner and one in the middle (chromium, tungsten, molybdenum). Face-centered cubes have atoms at each corner, but in addition, one on each face of the cube (nickel, copper, aluminum).

Iron, however, is unique since it changes or transforms from a body-centered cubic structure (alpha iron) at room temperature, to a face-centered cubic form (gamma iron) when heated to 1, 670 F.

And if heated to 2,550 F, the gamma iron reverts to a body-centered structure (delta iron) which melts at approximately 2,800 F. The reverse cycle takes place at the same temperatures when cooling.

Iron in a pure state is very soft with little or no toughness and unsuitable for most applications requiring impact or stress resistance. However, if another element, such as carbon, is introduced in varying degrees, it then becomes a hard, tough alloy with great strength.

As a rule of thumb, iron alloys containing up to 2% carbon are known as steel; more than 2%, they are known as cast iron. Both iron and steel alloys often contain other elements to give additional desired physical properties and when alloyed with these, an infinite variety of steel and iron alloys are produced.

Under conditions of equilibrium (slow, controlled cooling) carbon steel will pass through three phases of crystalline structure: austenite (a solution of carbon in gamma iron); ferrite (a solution of carbon in alpha iron); and cemenite (a compound of carbon and iron).

Steel's ability to change its atomic structure when going through these transitions obtains some very valuable characteristics, but also present some problems.

Much of steel's usefulness depends on changes made in its structure by rapid cooling or non-equilibrium. Steel can be hardened; its tensile strength varied, its ductility altered. It can be very easy to weld or made extremely difficult.

CROSS-section of perfect weld on low-alloy high-tensile steel. Note absence of cracks, porosity. Proper use of preheat permits such results on hard-to-weld steels.

These variations are a result of several factors, such as alloy content and cooling rate.

Some changes in crystalline structure occur well below the temperature at which the metal solidifies. These, if they occur, have a great influence on welding results.

At 600 to 700 F, depending on carbon content, rapidly cooled steel can form a structure known as martensite, a hard, brittle formation with little or no ductility. While good for hardening steel, it is not good in, or adjacent to, a weld.

Under stress conditions created by cooling shrinkage, martensite can cause cracks and ruptures in the weld

zone. Cooled to about 400 F, a weld zone can exhibit cracks and fissures generally associated with hydrogen diffusion in the heat-affected zone.

One theory explains this low-temperature cracking as recombination of hydrogen accumulated in microscopic voids and fissures in the weld area. Its tremendous pressure causes embrittlement which frequently results in weld failure.

Application of even a modest amount of preheat can sufficiently slow the cooling rate to eliminate or minimize martensite formation and promote hydrogen diffusion.

If a weld is made between two steel parts, weld heat causes a radical heating and cooling cycle in the weld area. During heating, the weld and immediate adjacent area are subject to local expansion; on cooling, to contraction.

If the parts joined are held rigidly, the weld, while still plastic, will be subject to plastic flow or deformation to accommodate the contraction. On further cooling the weld solidifies and, because of its greater strength, resists further plastic deformation.

This sets up a severe mechanical stress borne by a very small area, and if great enough, can result in weldment distortion or cracking.

By properly applying preheat, the reaction stresses in the weld can be reduced by distributing the expansion and contraction forces over a much wider area, and by enlarging the area over which the stress differential is applied.

Briefly, then, preheat is beneficial in three ways:

(1) Promotes the formation of a tougher, more ductile weld due to metallurgical changes.

(2) Promotes the diffusion of hydrogen out of the weld zone to eliminate underbead cracking and embrittlement.

(3) Lowers residual mechanical stresses in the weld area.

Basically, preheating should be used on any application involving alloy steels, armor plate, high-carbon steels, heavy steel sections and certain chromium stainless steels. It should be used in any steel application where problems of distortion, cracking or excessive hardening are encountered.

If doubt exits, it is safer to use preheat to insure best results. Properly applied to the right material, it will do no harm and can only have a beneficial effect.

Just as there are various processes and methods of welding, there are different methods of applying preheat. Determining a particular method will depend on a number of factors: temperatures required; weldment size, contour or shape; handling and heating facilities, preheat costs; and personnel ability.

Each preheating method has inherent advantages and disadvantages, so any one might be selected under certain conditions for a specific job.

Soaking in a large furnace is excellent for obtaining uniform preheat throughout the entire mass at a precise temperature. But not every shop has a large furnace and installation represents a major investment.

Since weldment removal is required, the structure must be heated somewhat higher than necessary, and a close check kept on the temperature so that reheating can be done when heat has dropped below the preheat value desired.

Induction heating is very rapid and efficient, and is well adapted for higher temperature applications (reaching forging temperatures in a matter of minutes). However, it is not especially well adapted for large structures of odd or uneven contour and is best suited for pipe and bars.

Hand torch local heating is the least desirable and hardly practical where any amount of preheating is required. Heat input is difficult to control, time consuming and is very inefficient. Uniform preheat is virtually impossible.

Natural gas heating is a rapid, economical and efficient method. However, temperature control is also frequently difficult and requires continual supervision.

This method involves a make-up of manifold burners, which on large, complex structures is difficult, costly and frequently impractical. Thus, it is not particularly well suited for large, odd-shaped weldments.

Electrical strip heaters are an easy, practical and reasonably economical method of preheating. Main application is on large, complex structures not readily moved or positioned, and on odd-shaped or contoured weldments where required preheat temperatures range to about 400 F.

Compact strip heaters are firmly attached to the work adjacent to the weld area. Preheat is then introduced into the work by radiation and conduction from the heater element which is in intimate contact with the work surface. The element remains in operation during actual welding. Thus, preheat is constant and uniform at all times.

Maintenance of a constant unvarying temperature is absolutely essential for best welding results. The time saved by not interrupting the welding cycle is an important economic consideration, permitting better scheduling and increased production.

Strip heater systems have been used as "custom" or hand-made equipment with heater elements put down by various methods and connected to a convenient power source on a temporary basis.

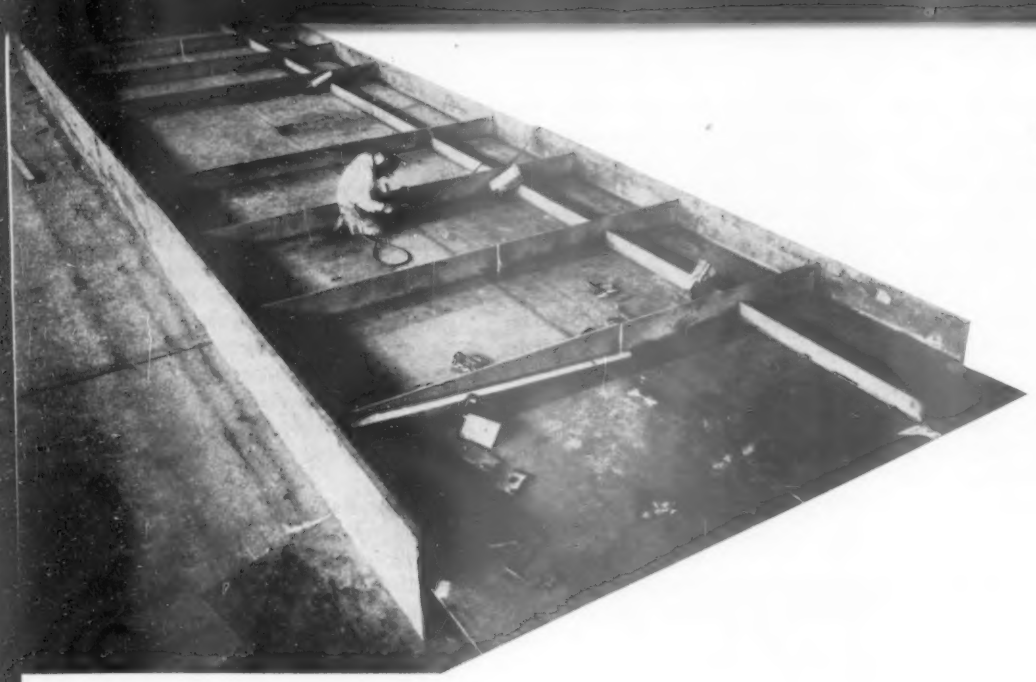
As a result, exposed electrical terminals encouraged flashovers, shorts and grounded circuits. Personnel safety, equipment protection, excessive prices, high labor costs of skilled electricians were all involved in a system which then ended on a scrap heap.

Despite these disadvantages, homemade electrical strip heater systems proved their worth.

A complete, balanced and integrated heater system featuring polarized connections and a simple, logical building block design has been manufactured by J. B. Nottingham & Co., Inc.

The system is quickly and easily erected on the job by unskilled labor and is just as easily removed. Polarization eliminates the danger of improper connection while neoprene plugs and connectors provide insurance against grounding, shorts and flashovers.

The unit can be expanded or added to as the job progresses, and at the same time, its design prevents accidental overloading by addition of heaters on a random basis. Thus, reliable operation, continuous heating, safety, reuse and longlife, and versatility are always assured, according to the company.



GIRDER halves are fitted up in shop for checking after welding webs to flanges and vertical and horizontal stiffeners. Overall depth is 16 ft 8 in., length, when completed 375 ft.

by **John R. Gray**
West Coast Steel Works

SUPER-SIZE bridge girders fabricated for Mt. Raiñier National Park

ORIGINAL SPECIFICATIONS for a riveted bridge to span the Nisqually Glacier at Mt. Rainier National Park in Washington, called for 1,377,000 lb of riveted steel plate. But, by redesigning the bridge for arc-welded construction, 118,000 lb of steel was saved.

First bids called for either a 440-ft prestressed box girder with 295 ft of concrete box girder approach spans; or 375 ft of riveted steel plate girders, with 310 ft of concrete box girder and 50 ft of riveted steel plate approach spans.

In the final redesign, the 375-ft main span was fabricated in two girders of eight sections each, ranging in length from 40 to 61 ft. Each girder section comprises two units, upper and lower, welded together longitudinally in the field to make a maximum girder depth of 16 ft 8 in. Roadway width is 28 ft, and each assembly weighs 225 tons.

Most of the welding was done with manual and semiautomatic setups in the shops of West Coast Steel Works, Portland, Ore. Field construction was handled by Carl Halvorson, Inc., general contractor.

The welding of girders, from shop fabrication to field erection, was accomplished in eight steps, four in the shop, four in the field.

First, flanges and webs were submerged-arc welded, then the webs joined to flanges, welding from one end to the other. Next, intermediate vertical stiffeners were welded to the web while in a flat position, and finally, most of the longitudinal stiffeners were joined to the web. Complete half-girders were then trucked to the field.

In the field, construction started with welding horizontal webs at the center line section while in a vertical position. Horizontal splices on intermediate stiffeners, and major web-to-web splices were then made. To complete the job, major flange-to-flange splices and web to flange welds at the splice points, were made.

To make the girders, half-sections were fabricated with just one flange plate. Steel of ASTM specification A-373 was selected for webs and flanges, with A7 for all stiffeners, bracing, bearings and expansion joints.

The heavy flange plates range from 1-in. up to 4-in. thick and 29

in. in width. Splice joints in these plates have double-Vee grooves, with a 60 deg included angle. The shallower groove, on the underside of the joint, was held to a maximum depth of ¾-in.

A ⅛-in. diameter spacer rod was laid in the root of the groove before welding operations started, the plates being beveled to a point at the root to bear against the rod. Preheating to 200 F was needed for butt welds in heavy sections, with asbestos mats applied for slow cooling.

Multiple passes were necessary to fill the deep grooves, and the submerged-arc process, using Squirt welding equipment, speeded this operation. Chipping out followed most passes. The same type of joint was developed for field splices in the flanges, with the exception that the welding was done, for the most part, manually. Lincoln Electric Co. equipment was used.

Web to flange welds are ½-in. double fillets, laid down in two passes with a self-propelled and fully mechanized welder. The assembly was tipped at an angle of 45 deg to permit welding the fillet in a flat position. Web plates are ¾-in. thick and stiffeners 11/16-in. thick.

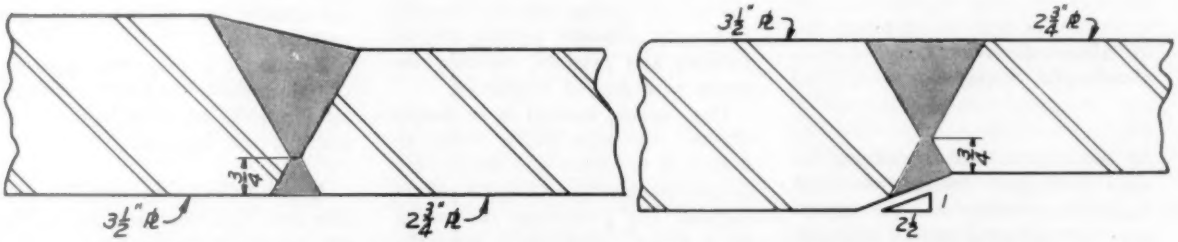
High tensile steel bolts were considered for major web and flange field splices, but the required size—up to 1¼ in. round and 14 in. long—plus excessive amounts of splice plate materials, dictated a switch to fully welded field joints.

Cobalt, iridium and X-ray inspection was made on overhead welding of field flange butt welds after gouging and before downhand welding started. Radiographic inspection was made on all flange butt welds handled in the shop.

Low hydrogen welding electrode, E7016, along with iron powder E6024 and E6027 types were applied extensively on manual welds of thick sections. The aim, of course, was for a fast fill and deposits of maximum soundness. When submerged-arc welding, mild steel wire of 5/64-in. diameter was specified, and used with a neutral agglomerated flux.

Main girders are tied together with plant-and-angle cross bracing and floor beams, mainly of arc-welded construction, which permitted a high degree of standardization and simplification in structural members.

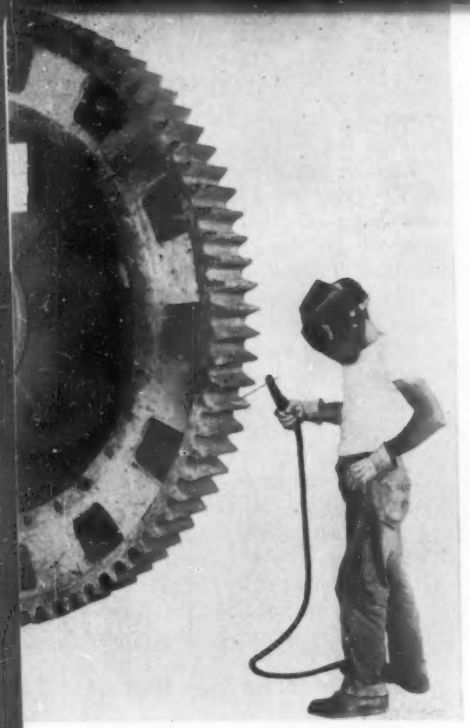
The bridge, built for the Bureau of Public Roads, U. S. Department of Commerce, replaces two smaller spans washed out by floods from the melting glacier.



SKETCHES showing typical field splice in flange plates of different thickness in top (left) and bottom girder flanges. Rod of ⅛-in. diameter is laid at root of 60 deg Vee-groove.

SEMIAUTOMATIC submerged-arc welding gun is guided along deep groove in flange joint by means of track and carriage. Groove is double-Vee, with runout tabs for full transverse at ends.

WITH girder half set at 45 deg angle, web-to-flange ½ in. fillet is made in two passes with self-propelled welding gun. Flange is 4-in. thick, web is ¾ in. thick.



Production, properties and uses of build-up electrodes

by **Albert J. Zvanut**
Metallurgist, Stoody Co.

As REBUILDING and reclaiming of worn steel parts becomes standard maintenance procedure, the importance of build-up electrodes increases enormously.

These build-up materials are used in two different ways:

(1) Restoring to original size and shape such parts as shafts, tractor track rails and parts which are to be finish machined.

(2) Rebuilding equipment (tractor rollers, idlers, mill hammers, drive sprockets) subjected to severe wear, impact or corrosion.

These latter parts must be returned to original size and shape by first using a build-up material followed by a suitable hardfacing alloy overlay.

In such cases, rebuilding is stopped short of final size so that the hardfacing overlay may return the part to original dimensions.

The final hardfacing overlay is then applied to produce maximum service life. The build-up material alone cannot provide this because of its low-alloy content and consequent lack of wear resistance.

Build-up electrodes are mild steel or medium carbon rods to which a coating has been added. Normally, the coating carries alloying elements to supply necessary welding characteristics and produce low-alloy deposits with desired properties.

One coating method is to simply dip the core wire into a slurry, allowing it to drain and finally dry to give the coating a proper moisture content. The percentage of coating on a dipped electrode is generally 10 to 12% by weight, usually graphitic and contains small amounts of chromium, manganese, silicon.

Another method is to pass the core wire through an extruding machine which applies a heavier coating under high pressure. Here the coating percentage is greater, generally between 15 and 28% of total weight, and the proportion of alloying ingredients is considerably higher.

A third method also uses extrusion, but differs from the second in that the coating contains a high percentage of iron powder as well as other alloys.

The coating on these iron powder electrodes will constitute 30 to 50% of the total weight. Faster melt-off and deposition, resulting in lower cost of deposited metal, are the main advantages. Savings may run as high as 90 cents per pound.

When applied to ordinary base metals, further advantages are the lower heat input and lower penetration, smoother operation, no spatter and easy slag removal. (Although higher currents are used, penetration is reduced since the added electrical energy is consumed in melting the iron powder.)

Deposit properties of a build-up electrode are important. The deposit must be sound, free of pinholes, cracks and inclusions while the material should have low crack sensitivity and, when required, must be machinable with either high-speed or carbide tools.

Because it is frequently necessary to restore much lost metal, any build-up electrode must be suitable for multiple-pass deposits.

A good build-up material must also have high yield strength, a property which reduces cracking potential of the overlaying material. If yield strength is low, the deposit will deform (cold flow), depriving the overlay of proper support.

Ductility is an absolute essential since it protects the deposit against sudden fracture. Loads are distributed evenly in ductile metals, but in low-ductility ones, the load is concentrated on a small area.

Good tensile strength and ductility are the properties generally accepted as determining the toughness of a

Electrode	Current (amperes)*	Melt-off Rate In./Min.	Deposition Rate Lbs./Min.	Percent Efficiency
Iron Powder				
Electrode A	250	12.4	.105	62
Electrode B	220	11.3	.09	59
Conventional				
Electrode A	190	8.2	.06	57
Electrode B	190	8.5	.06	66
Dipped				
Electrode A	180	10.1	.08	74
Electrode B	180	9.7	.077	72

*Current recommended by electrode manufacturer.

TABLE I—Comparison of melt-off and deposition rates of three types of build-up electrodes.

Electrode	% C	% Mn	% Si	% Cr	% Mo	% Ni	Hardness R_C*
A	0.14	1.10	0.63	0.49	--	--	12
B	1.32	0.42	1.24	--	--	--	42
C	0.06	0.22	0.07	--	0.39	1.97	7
D	1.62	0.32	0.69	--	--	--	45
E	0.12	0.43	0.32	1.90	--	--	28
F	0.16	0.34	0.35	--	0.60	--	21
G	0.39	0.58	0.28	--	--	--	17
H	0.59	0.41	0.50	--	--	--	26
I	0.13	0.59	0.31	0.55	--	--	21
J	0.32	1.11	0.63	3.1	0.42	--	50
K	0.11	0.40	0.95	0.55	0.92	1.66	24

*Two-pass deposit, cold interpass temperature, on S.A.E. 1040 steel

TABLE 2—Analysis of all-weld-metal deposits made with 11 of the most popular build-up electrodes.

weld deposit, and toughness is a major consideration.

Unfortunately, high levels of strength are obtained only by sacrificing ductility. A compromise must therefore be made between a material possessing high strength and resistance to cold flowing, and one with lower strength, high ductility and a tendency to cold flow.

Machinability depends in part on deposit hardness which can be controlled not only by material analysis, but by application, preheating, slow cooling or heat treatment.

Obviously no single electrode can supply all properties needed to meet every possible application. So most manufacturers confine production to one electrode adapted to average needs.

More than 25 build-up electrodes are now on the market, and a survey shows a startling variation in deposit analysis and resulting physical properties.

While differing widely in analysis, hardness and other properties, most electrodes are recommended for tractor rail rebuilding. These rails flex in operation and if the deposit is not ductile enough, cracking and subsequent spalling are likely.

Many of the electrodes listed in table 2 will not produce the desired ductility and other properties necessary for satisfactory service life.

To determine the best build-up electrode for this application, several factors must be taken into consideration: condition of the tractor and the worn track link, type of service expected and the condition of the tractor rollers.

Some manufacturers feel an electrode hardness range between 28 and 34 Rockwell C will produce the best service life, yet few of the electrodes fall within this range.

Although the analysis of the electrode goes far in determining deposited hardness, method of application and the technique used permit a wide variation in hardness values. Preheat and cooling rate may radically change the deposited metal's structure and hardness.

Cooling rates normally encountered in welding do not approach those of a water quench or furnace cool, but it is possible occasionally to obtain cooling rates that will differ from those in the as-deposited hardness column in table 3.

It is readily possible to obtain hardness on 1040 steel between the extremes shown in the last two columns. The hardness appearing in the manufacturers' literature is of necessity an average figure which may be changed considerably by many welding variables.

A comparision of columns one and two in table 3 indicates wide variations between the figures of some manufacturers and actual test results.

Welding variables, aside from analysis and cooling rate, which definitely affect the deposited hardness of the build-up material are: electrode design, base material analysis and the weldor's technique for controling base metal dilution.

For example, if electrode A in table 2 were deposited in a single pass rather than two passes, the hardness would be appreciably lower due to dilution from the base metal. Stringer beads result in higher hardness than weaving passes.

Bead size and shape, electrode size, current type and polarity also vitally effect resulting hardness.

Thus analysis, hardness and the widely varying welding procedure often leave the consumer at a loss in determining the performance he can expect from any given electrode. Most manufacturers recognize this problem and maintain welding engineers to assist in selection of proper materials for a given application.

Many also provide complete data on their build-up electrodes so the weldor, by adhering closely to recommended procedures, may generally be assured of satisfactory results.

Because deposit properties are influenced to a considerable degree by the type of current (a-c or d-c) used, and by polarity, the manufacturers' recommendations should be followed specifically.

In the hands of a skilled weldor, any build-up electrode of good analysis can be applied to produce deposit characteristics that will make it suitable for service under a great many operating conditions.

Electrode	Hardness From Mfg's Lit. Rockwell C	Hardness* Rockwell C As Deposited	Hardness Rockwell C Water Quenched From 1600° F.	Hardness Slow Cooled From 1600° F.
A	29-31	12	40	81 R_B
B	35-40	42	68	24 R_C
C	10-15	7	43	74 R_B
D	25-30	45	66	24 R_C
E	21-34	28	44	85 R_B
F	18	21	38	78 R_B
G	25-40	17	58	82 R_B
H	30-40	26	62	89 R_B
I	21-30	21	40	84 R_B
J	24	50	53	33 R_C
K	28-34	24	35	20 R_C

*Two-layer weave deposit on .40% carbon plate. First layer water quenched; second layer air cooled. Deposits made using manufacturers' recommended current.

TABLE 3—The effect of different cooling rates on build-up electrodes analyzed in table 2.

FEEDBACK control pickup leads are connected to upper and lower electrodes so that the Monautronic unit can compensate for weld variations.

- Consistent quality
- Less inspection
- No rejects

New spot welding control makes its own ideal welding conditions

IDEAL CONDITIONS for resistance spot welding regardless of actual conditions normally affecting weld quality is the end result of a new welding control utilizing feedback principles.

According to The Budd Co., Philadelphia, the control compensates automatically for variations in line voltage, applied force, electrode wear, surface finishing, fitup, thickness or hardness of material, shunting and any other conditions that would result in substandard welds with conventional controls.

The Monautronic V-2, as the control is called, obtains correct fusion temperatures within each weld by relating the voltage across a given weld area to the ultimate temperature that will occur within the weld.

Actual voltage is then measured at the weld electrodes and compared to a "command" voltage related to the desired temperature.

This desired temperature, a known quantity based on previous welding experience for that particular type and thickness of metal and desired weld strength, had previously been "programmed" into the control. Thus the command voltage instantly compensates for any difference between the two voltages by making automatic heat adjustments for each weld as it is being formed.

The feedback information on the voltage across the weld is processed by appropriate input circuits, similar to those in radar and both digital and analog computers.

This information makes the heat-input setting fully automatic regardless of variations. However, if conditions develop which would result in a substandard weld and which are beyond available control range, the control unit senses a good weld cannot be made and "locks out."

Thus, the welding operation is automatically halted so that the operator can correct the nonweldable condition, reset the control and then continue the welding operation.

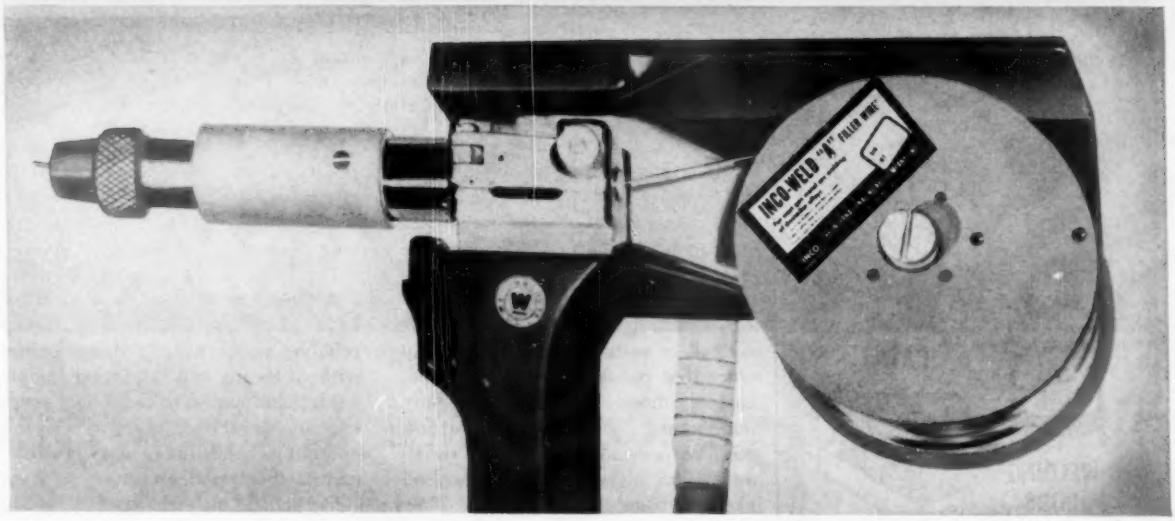
With average settings the control unit holds electrode voltage constant to within ± 10 millivolts, with a settling time (time required for command voltage to correct electrode voltage) of 33 milliseconds, or less than one-half cycle.

If the weld-stopping condition is not corrected, the unit will lock out again. Moreover, if the conveyor line should jam, a second weld cannot be made on top of the first, since the control automatically senses one weld has already been made and would lock out.

(With conventional controls, a conveyor line jam-up usually means at least one ruined assembly caused by over-welding in the same spot, plus lost time and the cost of replacing electrodes.)

With proper heat setting as determined by past experience, spitting or sparking at the electrodes is greatly

"67" 70/30 COPPER NICKEL FILLER WIRE
INCO-WELD "A" FILLER WIRE
"60" MONEL FILLER WIRE
"61" NICKEL FILLER WIRE
"62" INCONEL FILLER WIRE



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- "60" Monel* Filler Wire

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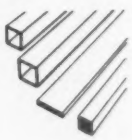

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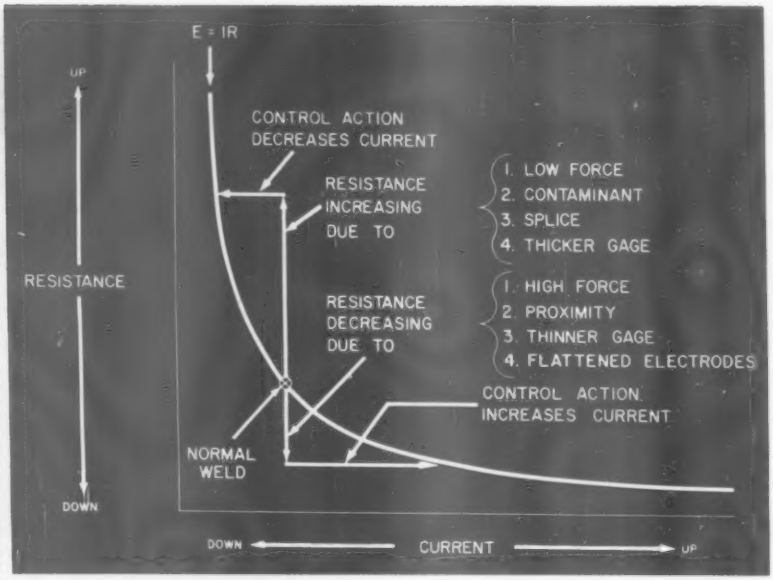


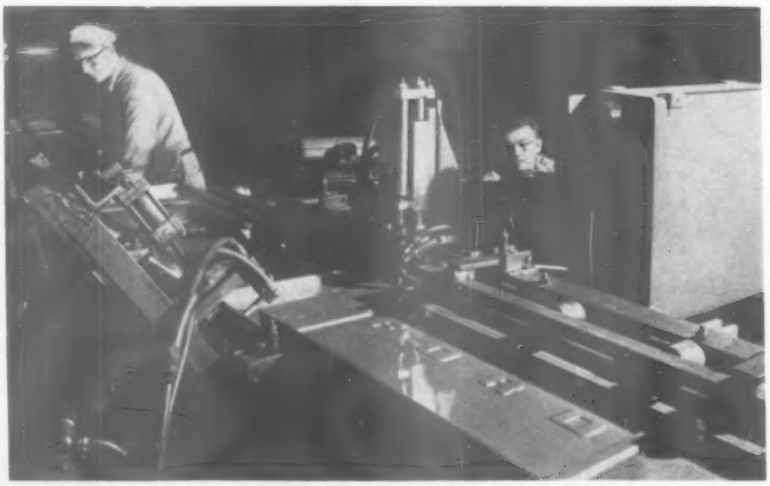
VOLTAGE control compensates for process variations. Any point on curved line represents a specific voltage. With normal weld as reference, variations cause increases and decreases. Control action through current change constrains voltage to same level for every weld.

reduced. With conventional controls this would mean weld metal expulsion and reduced weld strength. Reduction or, in many cases, elimination of spitting in turn greatly reduces hazards to the operators.

According to the company, the control is suitable for use on any metal that can be resistance welded. Among those metals successfully welded are: stainless; low-carbon steel; carbon-moly steel; heat resistant alloys; nickel alloys; galvanized iron and titanium (as well as other exotic metals under carefully controlled conditions).

Galvanized iron and vinyl-clad steel, hitherto extremely difficult to resistance spot weld because of the coating's electrical effects, are now readily welded with the Monautronic control.

Other features of the unit listed by the firm include: consistent and reliable welds over a long period without testing and inspecting sample welds; elimination of redundant welding and rejections due to varying operating conditions; easy maintenance; shock and vibration resistant construction; safety interlock; fully automatic sequencing with all provisions for 100% accurate single-spot, roll spot or seam welding.



COMPARISON test between conventional (left) and Monautronic (right) controls shows excessive metal expulsion, which is uncorrectable, from the conventional method.

R. W. Creamer, V.P., checks x-ray films of tank welds.

Picture of a man saving $400 per unit

It's done with Kodak Industrial X-ray Film, Type AA

Creamer and Dunlap, Inc., make pressure vessels—big ones, 67 ft. long by 9 ft. in diameter. Because they radiograph every inch of every weld to determine soundness, they can use thinner plate. This results in about 10% less weight with attendant savings in fabrication, handling and shipping. Altogether it adds up to as much as $400 per unit.

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For inspection of welds, Kodak Industrial X-ray Film, Types AA, M, and KK, are available in the 70mm by 550 ft. package, as well as in standard sheet sizes.

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• The only *sure* way to get a dependable weld—a non-porous weld, free from cracking—is to use a welding wire which will give weld metal compatible with the base metal, and which contains deoxidizers designed to eliminate all impurities.

PAGE has had more than 50 years of experience in the development of welding wires for specific jobs. As a result, you can get the wire best suited to your welding job—and you can get it from local stocks, packaged in the way that fits your own production requirements.

AUTOMATIC WELDING WIRE

A choice of 33 analyses of automatic welding wire enables you to get the *exact* wire you need for any welding operation. Here are some examples:

A-S-Armco • a pure iron for welding "Armco Iron," which contains other elements in a quantity guaranteed to be less than 0.1%.

A-S-6 • for welding mild steel with exceptional ductility—50,000 p.s.i. average tensile, with 35% elongation.

A-S-10 • a low-carbon mild steel, chiefly used for submerged arc welding.

A-S-15 • an aluminum-killed mild steel which gives a tensile strength of approximately 75,000 p.s.i. with 40% elongation.

A-S-16 • the same as A-S-15, but with molybdenum added for higher tensile strength.

A-S-17 • a modification of A-S-10 with silicon added for use with inert gas.

A-S-18 • the first successful wire for CO_2 welding of high-carbon and sulfur-bearing steels and for general use on low alloys.

A-S-20 • a high-tensile submerged arc rod, also suitable for CO_2 welding.

A-S-25 • a modification of A-S-20, with deoxidizing agents added for better CO_2 welding.

A-S-30 • produces porous-free weld metal, even on a very dirty steel. Contains up to .75% aluminum for maximum deoxidation.

A-S-65 • reasonably priced for hard-facing with high resistance to abrasion or erosion.

A-S-4130 • a medium carbon, chrome-molybdenum alloy for welding the SAE 4100 series of low alloys.

A-S-6150 • a low alloy hard-facing rod, producing a Rockwell hardness of C-32 which can be machined or ground.

A-S-8620 • contains chromium, nickel and molybdenum, and can be used with any low alloy containing any or all of these metals, even when the exact analysis is not known.

A-S-Stainless • several stainless wires are available to match the various grades of stainless steel.

METAL SPRAY WIRE

Metal spray wires generally deposit a coating of the same analysis as the wire employed, and this deposit may be built up to any thickness. The deposit is porous and has little tensile strength, but provides excellent anti-frictional characteristics and resistance to abrasive wear.

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PAGE electrodes are available for use with Armco, mild steel, low alloy and heat-treatable steels, and for impact-resistance surfacing.

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PAGE gas welding rods are available in any of the analyses for welding wires. Any welding wire grades listed can be furnished in 36″ straight lengths for gas welding rods. Rods also can be furnished in coils and on reels.

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From our 33 analyses, we usually can prescribe the wire best suited to your requirements. We also can develop special wires when needed to solve a particularly tough welding problem. At all times, PAGE welding specialists are ready to give expert advice. Call on us for help.

Liner markings on each coil of PAGE welding wire provide positive identification, end mix-ups. And on #2 coils, liners are color-coded as well. The color of the stripe indicates the grade, makes identification double-quick and fool-proof.

Perfect weld of SAE 1141 to SAE 1151 was accomplished with A-S-18, using CO_2, to form an automotive drive shaft. Note clean metal in cutaway portion shown at left. There's no annealing of the high-carbon resulfurized steels, because preheat and post-heat are not required.

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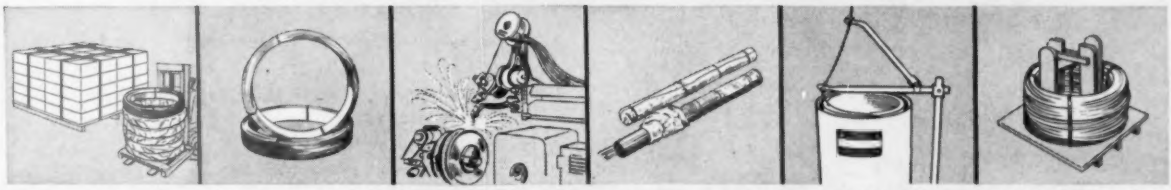

25-lb. or 60-lb. coils, single or palletized—also in single or palletized individual cartons, or in waterproof reusable fiber-board drums.

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ACCO

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by **Forest S. Major***

STEEL plate work being assembled for welding (right). Below, energized magnets, placed during assembly, are pulling two steel plates upwards against I-beam with force of 4,500 lb, making flush connection along which weldor can run his bead. Black stiffener connecting magnets exerts downward push against magnetic force, assuring against movement during welding, and doing away with strapping.

Careful assembling can cut fabrication costs

STEEL-PLATE FABRICATORS are continually complaining about the high cost of assembling welded jobs. They are forever trying to devise better and speedier methods of fitting up.

In truth, most of the difficulty is caused by careless preliminary operations, such as laying out, shearing, torch cutting, planning, bending and shaping. If these operations are accurately performed many valuable hours will be saved in assembling and welding.

The successful assembly of welded steel-plate work of various descriptions depends upon the careful and proper preparation of the material. When laying out the work allow proper clearances at the welded joints, so that cutting, chipping and grinding are kept at a minimum. Shearing, planning and torch cutting should also be performed carefully and accurately to save assembly time.

Foremen sometimes criticize a man who is assembling a welded job for taking too much time, when in reality the work was not laid out correctly, and was carelessly cut and formed.

After all parts are properly prepared, assembly begins. Extreme care should be taken to keep center lines, openings, bolt holes, flanges, etc., in correct position. If some parts are to be welded before complete assembly, which is often necessary, expansion and contraction of welds must be allowed for.

In cases where it is possible to do so, it is best to completely assemble the job before welding. There are exceptions, of course, such as when welding must be done as assembly progresses. In such cases, careful and accurate preparation of the various parts is very important.

It goes without saying that the design of welded work is of utmost importance and is really the first step toward low cost of fabrication and quality work. When the assemblyman finds it necessary to cut tack welds in order to get other pieces into position, costs mount rapidly.

Sometimes he finds it necessary to flame cut plate edges or shapes which cannot be taken out. This results in high costs and delays, as well as inferior products.

Of course, some complicated and heavy steel-plate work is difficult and costly to assemble for welding. However, this is all the more reason for care being taken, starting with design and laying out and followed by careful preparatory operations for assembly.

*Plant manager, Burnham Corp., Lancaster, Pa.

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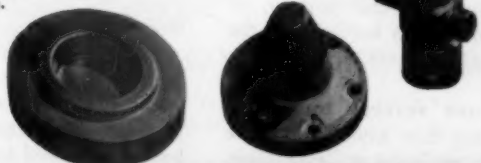

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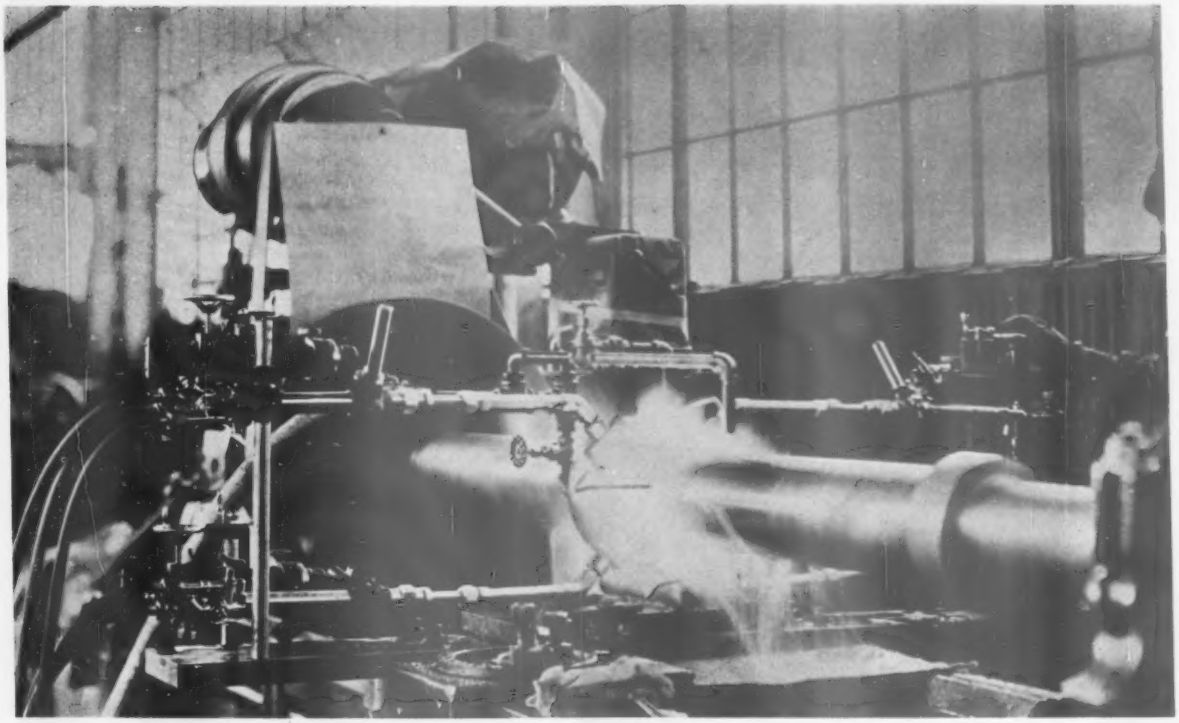


Hardening without hardfacing

By E. J. Pavesic

JUST AS THERE are several ways to weld metals so there are different means of hardening the surface of a metal part.

One of these ways is case hardening. Case hardening, as a metallurgist will put it, is hardening a ferrous alloy so that its outer portion, or case, becomes much harder than the inner portion, or core.

There are several means of accomplishing this, among which we can count carburizing, cyaniding, carbonitriding, induction hardening, nitriding, and flame hardening.

Principles behind all these processes are, nevertheless, the same: increase surface hardness so the unit can withstand more abrasion and impact when it is in service.

The reason case hardening is concerned mainly with the part's surface is that, if the core was as hard as the case, the whole unit would be so brittle that its usefulness would be destroyed.

Each zone, then, must have different hardness and mechanical properties like yield strength, tensile strength, reduction of area and elongation, the latter two properties being criteria of ductility rather than hardness.

Hardness in ferrous alloys is determined by carbon content. Steel containing 0.10% carbon, for example, can be hardened to 40 on the Rockwell C scale.

However, increasing a steel's carbon content above 0.60% does not result in a commensurate hardness increase. For example, 0.60% carbon in steel will have a hardness of 65 on the Rockwell C scale. But 1.0% carbon in steel will have a hardness of about 68 on the same scale; from a commercial standpoint the highest hardness practicable from steels and cast irons. (These quotations are dependent upon quench hardening to a microstructure essentially 100% martensitic, i.e., fully hardened.)

Additional wear resistance can be gained by adding alloy elements to the metal. Chromium, molybdenum, tungsten, and vanadium all combine readily with carbon to form hard carbides.

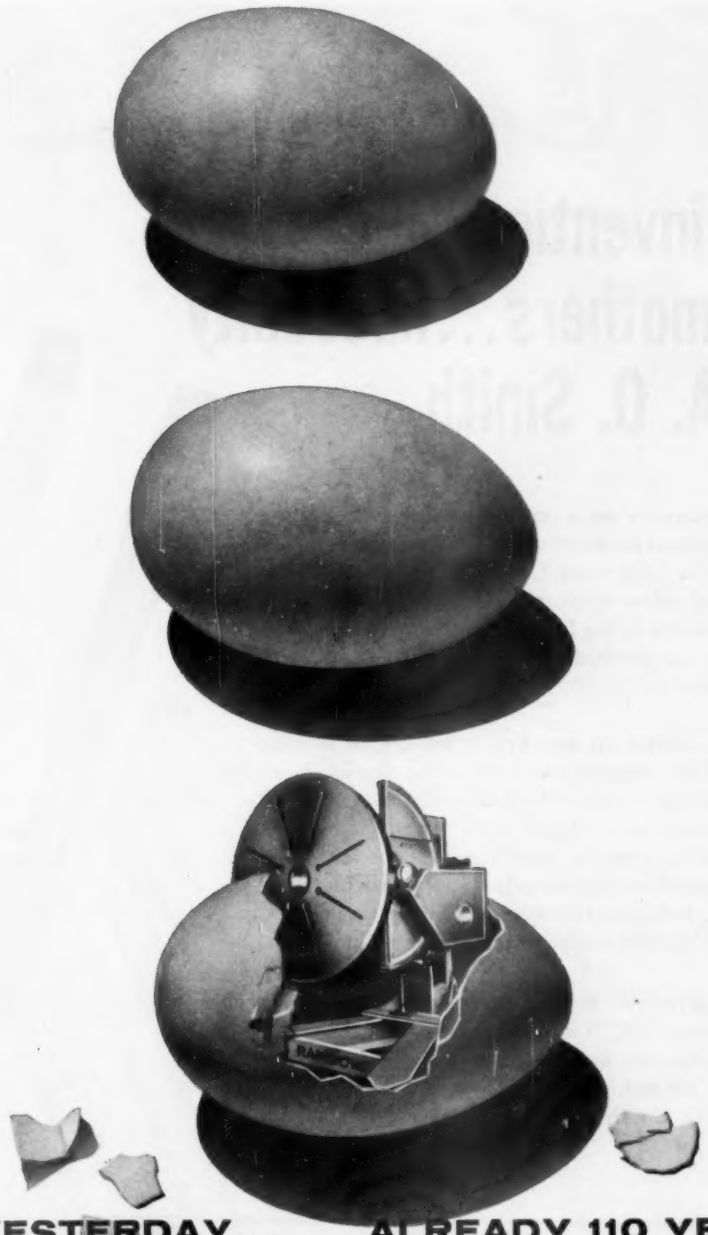
High surface hardness can be produced in steels with sufficient carbon content by selectively heating the outer surface layer to the hardening temperature and depth desired, then quenching at a rate that will produce complete hardening.

The area beneath the selectively-hardened zone will be unaffected by the heating and quenching. This is the principle used in flame hardening and induction hardening.

The flame method hardens steel by heating it above the transformation range (austenitizing) with a high-temperature flame held directly on the unit. The workpiece is then quenched at a rate which will produce complete hardening.

Fuel gases, such as oxyacetylene, oxypropane, or air and natural gas, can be used with the process. The oxyacetylene flame seems best adapted to the job because it produces highest work temperatures and because equipment is readily available.

However, so-called radiant and high-velocity burners or flame heads,



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1850-1943: Ransome Machinery Company was born and rapidly developed a reputation for quality and engineering in fine machinery. In 1932, Ransome perceived the need to free the weldor from the burden of "down time" and permit continuous downhand welding — pioneered the *first* commercial welding positioner — thereby created a new technology in the welding industry. **1943-1959:** Ransome Machinery Company became a subsidiary of Worthington Corporation and continued to develop the finest in welding positioning equipment. **TODAY:** Having acquired Worthington's positioning equipment business, the old reliable name, Ransome, rises again with renewed vigor . . . totally independent, newly organized with top veterans from Worthington and eager young talents. *Dedicated to its heritage, the* new *Ransome pledges to apply the old Ransome traditions of quality and creative imagination to serve your modern requirements in automation welding.*

Ransome Company

SCOTCH PLAINS, New Jersey

RANSOME...THE PIONEER IN POSITIONING FOR WELDING

Birth certificate of an industry...

This invention had two mothers...necessity and A. O. Smith

OUT OF NECESSITY BY A. O. SMITH is the way the idea of a paper-wrapped electrode was born. Necessity appeared on the scene in 1918 when German U-boats cut off the importation of asbestos-covered electrodes — electrodes desperately needed in the fabrication of aerial bombs. The need was for an electrode covering which made welds strong and *ductile*.

ENTER A. O. SMITH TO CREATE A NEW INDUSTRY — An A. O. Smith research team found the answer in an electrode with an arc-shielding wrapper of fireproofed (sodium silicate) paper. Here was a weld that was discussed around the world — an efficient (at the time) and economical electrode that not only solved a specific armament problem, but turned a primitive steel-splicing method into the world's most useful metalworking technique.

A. O. SMITH gives you the benefit of on-the-job welding experience. Since 1918, "firsts" developed on A. O. Smith's own huge production welding program have resulted in better and better techniques for the entire metalworking industry. A. O. Smith can truly say, "welding is our business."

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C-OMATIC — fully automatic CO_2 welding process, offering all the many advantages of CO_2 welding plus a history of automated production experience unmatched in industry. Just push a button — C-OMATIC does the rest.

A. O. SMITH WELDING ELECTRODES ARE MADE BY WELDERS FOR WELDERS

UNITED STATES PATENT OFFICE.

REUBEN STANLEY SMITH, OF MILWAUKEE, WISCONSIN.

ELECTRODE FOR ARC-WELDING.

1,301,331. Specification of Letters Patent. Patented Apr. 22, 1919.

Application filed December 6, 1918. Serial No. 265,524.

To all whom it may concern:

Be it known that I, REUBEN STANLEY SMITH, a citizen of the United States, residing in the city of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Electrodes for Arc-Welding, of which I hereby declare that the following is a full, clear, and exact description [illegible] will enable persons skilled [illegible] the invention pertains to [illegible] electrodes for [illegible] which a [illegible] by [illegible]

[illegible] these objections, by reason of the simplicity of its construction and its economy in cost of materials and process of making.

After much experimentation, in my attempts to simplify methods of arc-welding and my desire to produce an entirely satisfactory electrode, I have found that an iron or steel wire provided with a covering of paper, which latter has been treated as hereinafter described, may be used as an electrode in the [illegible] welding, with excellent results [illegible] found, also, that the coating [illegible] by the use of [illegible] not essential to [illegible] satisfactory [illegible]

In [illegible] the wire [illegible] be covered [illegible] and winding thereon a sheet [illegible] sufficient to [illegible] covering of necessary thickness for [illegible] electrode. The [illegible] of the sheet of paper and the consequent number of convolutions about the wire will be in proportion to the gage of [illegible] used for the electrode, which latter [illegible] determined by the character of the surfaces to be welded. In another form, the winding about the wire will be formed as a [illegible] from a comparatively narrow strip of paper, or a multiple number of strips of paper simultaneously wound, may be used. The sheet or strip of paper used as a covering is saturated or impregnated with sodium silicate, or other heat resisting compound, and such saturation may be effected [illegible] soaking the paper with the solution prior to winding the paper about the wire, or the [illegible] after being covered with paper, may be placed in an ordinary vacuum impregnating apparatus, to enable the necessary saturation to take place. After saturation, the electrode will be baked to expel a part of the moisture and harden the surface of the [illegible]

[illegible] provided [illegible] covering. [illegible] integrates [illegible] heat gen[illegible] [illegible] of the [illegible] quickly. [illegible] thereof [illegible] formed by [illegible] al, and is [illegible] for amal[illegible]

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using air-natural gas mixtures, are coming into wider use.

There are four main methods of flame hardening: spot, or stationary; progressive; spinning; and a combination progressive-spinning.

The spot, or stationary, technique consists of locally heating the area to be hardened to the desired depth and then quenching.

In the progressive method, the workpiece is heated progressively by the flame head and the quench is applied directly behind it. Either workpiece, or flamehead and quench may move.

During the spinning method, the workpiece is rotated while being subjected to heat from a single or multiple flame head. The unit is then immersion quenched.

A combination of progressive-spinning methods can be used if the workshop is rotated while being heated by the flame head (usually multiple) and then quenched.

Equipment for these techniques can range from a weldor's torch to custom-built, automatic units for spinning and progressive-spinning methods.

With this equipment and these methods, hardened zone depth will vary from 1/32-in. or more, depending upon fuel used, flame head design and length of heating.

Flame hardening is adaptable to any ferrous alloy which can be hardened by conventional heating and quenching. However, AISI-SAE 1035 to 1053 carbon steels are most widely used.

When special properties not obtainable with carbon steel are desired, alloy steels such as AISI-SAE 4140H, 8640H and 4340H are frequently chosen. Often flame-hardened, too, are gray and pearlitic malleable cast iron. Carburized parts are sometimes flame hardened in selective areas.

Flame hardening is effective on extremely large parts, difficult or uneconomical to harden by other methods, and on small areas or when the extremity of a part must be hardened.

Because of its ability to localize heating, the technique can be used on gears and intricate shapes without materially affecting dimensional accuracy. For example, the spinning method, when applied to hardening gear teeth, removes the necessity of further

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finishing operations. Other applications of flame hardening are on rolls and machine ways, valve stems, push rods, cams, and levers.

Flame hardening can sometimes replace carburizing. Savings can be made when plain carbon steel—flame hardened—is substituted for a carburized, low-carbon alloy steel.

Induction hardening is a quench hardening process in which heat is generated in the workpiece by electrical induction.

A high frequency alternating-current is passed through the inductor, or work coil, which induces the heating current in the workpiece. When proper temperature and heating depth are reached, the unit is quench hardened.

Most useful frequency range for surface hardening is from 1,000 to 3,000,000 cycle per second (cps). Depth of heating by induction is a function of time, power density, and frequency.

FLAME hardening is economical, effective means of stretching gear teeth life.

Three types of induction heating equipment are available commercially, each capable of producing different hardening depths. There is, however, some overlapping of their capabilities.

Motor-generator equipment is available with frequencies from 1,000 to 10,000 cps. Such units can harden material from about 7/16 in. to over 4 in. in diameter to depths ranging from 0.050 in. to 0.20 in.

Spark-gap equipment having a frequency range from 20,000 to 600,000 cps can harden workpieces from ¼ in. to 2 in. in diameter to depths ranging from 0.15 in. to 0.20 in.

Electronic tube equipment has a frequency range over 200,000 cps and exhibits the same capabilities as spark-gap equipment. However, case depths less than 0.015 in. require frequencies over 1,000,000 cps, which can be produced only by electronic tube equipment.

The two main methods of hardening steel by induction are: *(a)* stationary and *(b)* vertical or horizontal scanning.

In the first method, neither work nor inductor coil moves while the surface is heated to hardening temperature and then quenched by immersion or by a spray issuing through the induction coil itself.

Vertical or horizontal scanning involves progressively heating and progressively quenching by an integrated, or separate, spray. Rotating the work piece while it is heated promotes uniformity of heating depth and hardening. Movement of the unit in-and-out of the coil or block can be mechanized and the entire operation made almost automatic.

Materials used in induction hardening are similar to those employed for flame hardening. As maximum hardness in a given steel is governed by its carbon content, the metal must have the minimum carbon content necessary to produce the desired hardness.

If, for example, a Rockwell C hardness of 55 is required after induction hardening, the carbon must be 0.40% minimum. Hardness of 58 and 60 Rockwell C minimum call for minimum carbon contents of 0.45% and 0.50% respectively, and, of course, effective quench.

Countless units can be surface hardened by induction. Gears (teeth), shafts, cams, crankshafts, cylinders, and levers are but a few examples.

The advantages of induction hardening are very similar to those of flame hardening. But, because this equipment is substantially more expensive than that for flame hardening, its use is usually limited to items which can be produced in large quantities.

With induction hardening, the user can have a high degree of control, flexibility and reproduceability. Depth and contour of the hardened zone can also be controlled because of the wide range of frequencies available with the various units.

Hardening depth can be varied from 0.015 in. to 0.20 in. or more, and gear teeth and other irregular surfaces like cams can be contour hardened. Internal surfaces, as well, are often induction hardened. In recent years, the method has become part and parcel of machining operations on machine tools.

Some steels of low hardenability, such as medium-carbon types, e.g., AISI-SAE 1040 and 1045, when heated throughout and quenched all over, or time-quenched in certain sizes, harden only to relatively shallow depths.

Such steels will very much resemble parts which were flame hardened or hardened by induction. They will have a hard surface zone and a core of lower hardness and more ductility; unfortunately, more distortion will be present than in units hardened selectively.

Surface hardening can be obtained by yet another technique. That is, selectively quenching a shallow-hardened steel. In this case, the steel is heated overall, but only the area to be hardened is quenched by spray or immersion. Hardened zone depth will be ruled by the part's hardenability and mass.

Selective heating and/or selective quenching, then, are processes in which hardening depth is determined by: depth of heating; method of quenching, the material's hardenability. Degree of hardness is governed by the metal's carbon content.

"He wasn't worth a damn in the tree business either!"

Stainless alloy reclaims eroded silver brazed parts

SILVER BRAZED PARTS in which brazed joints fail to stand up under severe service conditions can often be reclaimed with a stainless type brazing alloy.

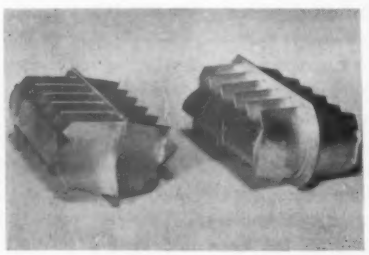
A case in point is a turning vane assembly used in jet engine compressors, where it is exposed to corrosive not gases.

This 321 stainless steel part was originally silver brazed. Although the assembly components usually stand up well in service, the joints tend to erode at higher operating temperatures. Because only the joints are damaged, the assembly itself is salvageable.

Reclamation, as performed by Stainless Processing Div., Wall Colmonoy Corp., Detroit, involves stripping all silver braze from the assembly and rebrazing with a nickel-base stainless alloy designed especially for high temperature service.

Stripping is accomplished using the acid bath method. When all silver braze has been removed, the components are reassembled and furnace brazed with the alloy at 2,150 F in pure dry hydrogen atmosphere.

Reclamation is considerably less expensive than scrapping the damaged parts; in addition, the rebrazed assemblies resist the erosive effects of the high temperature gases, thus prolonging the useful service life of the assembly.



JET engine compressor turning vane assembly following rebrazing with a nickel-base stainless alloy in pure dry hydrogen furnace. Part was originally silver-brazed, but joints could not stand up under exposure to erosive high temperature gases.

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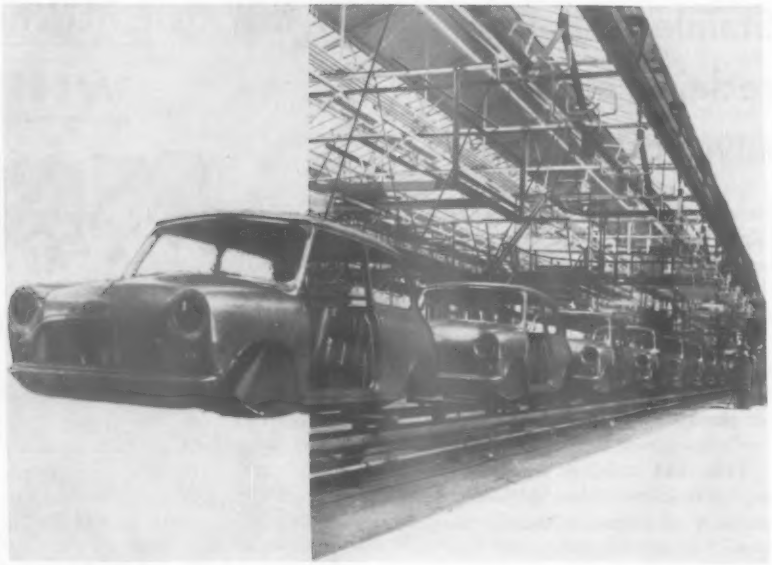
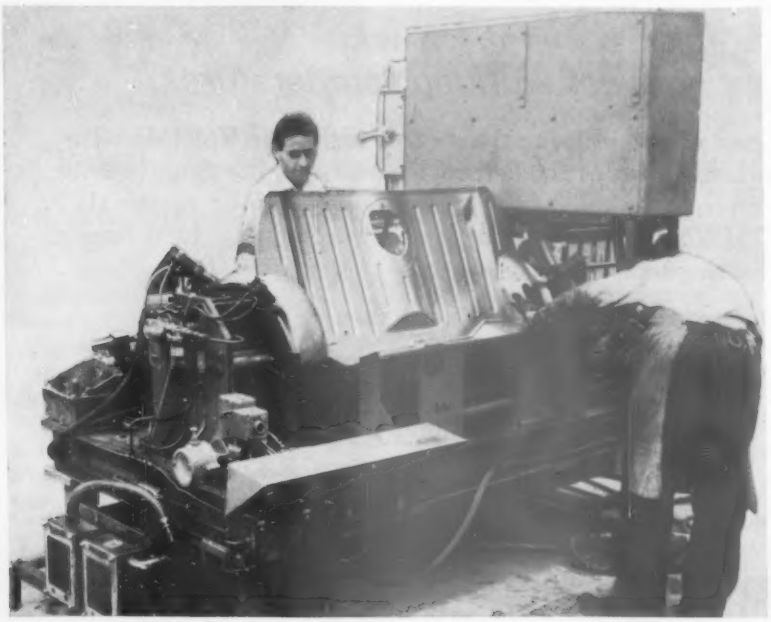


Multi-spot welders ensure minimum weight, maximum strength

MULTI-SPOT WELDING machines are playing an important part in high-speed assembly of British Motor Corp.'s Austin Seven, a 70 mph "baby" car with an expected production peak of more than 3,000 per week.

Basic design is an all-steel body with the chassis (two-sub-frames, one in front and one at the rear) as an integral part. Company engineers specified this design because of the engine mountings and chassis frame, as well as the need for minimum body weight and maximum strength.

To fabricate this "baby" car, specialized equipment enabling a large number of high-quality spot welds to be made simultaneously was required. The multi-spot welders (supplied by Electro Mechan-Heat Ltd.), incorporate locating and jigging fixtures and air-operated ejection mechanisms to ensure high accuracy and speed.



REAR floor panel is welded to rear wheel arches and seat panel by means of eight spot welds on either side.

The six welders and their operations on the company's assembly line are as follows:

(1) A multi-spot welder for attaching the rear seat panel to the rear wheel arches by means of eight spot welds on either side.

In this welder, four 75 kva transformers are connected across the 3-phase power supply with an electronic control unit firing the first two transformers together and the others one at a time.

A 5-stage weld timer provides sequence switching of the three ignitron contactor units mounted inside the control cabinet, giving three weld sequences, a forge-time cycle and an interlock stage.

Components to be welded are pneumatically clamped in position on a hand-operated trolley, which, when pushed into the welding position, is pneumatically locked. The weld cycle then automatically starts.

(2) A multi-spot welder for attaching the rear floor panel to the rear wheel arches and seat panel assembly by means of eight spot welds

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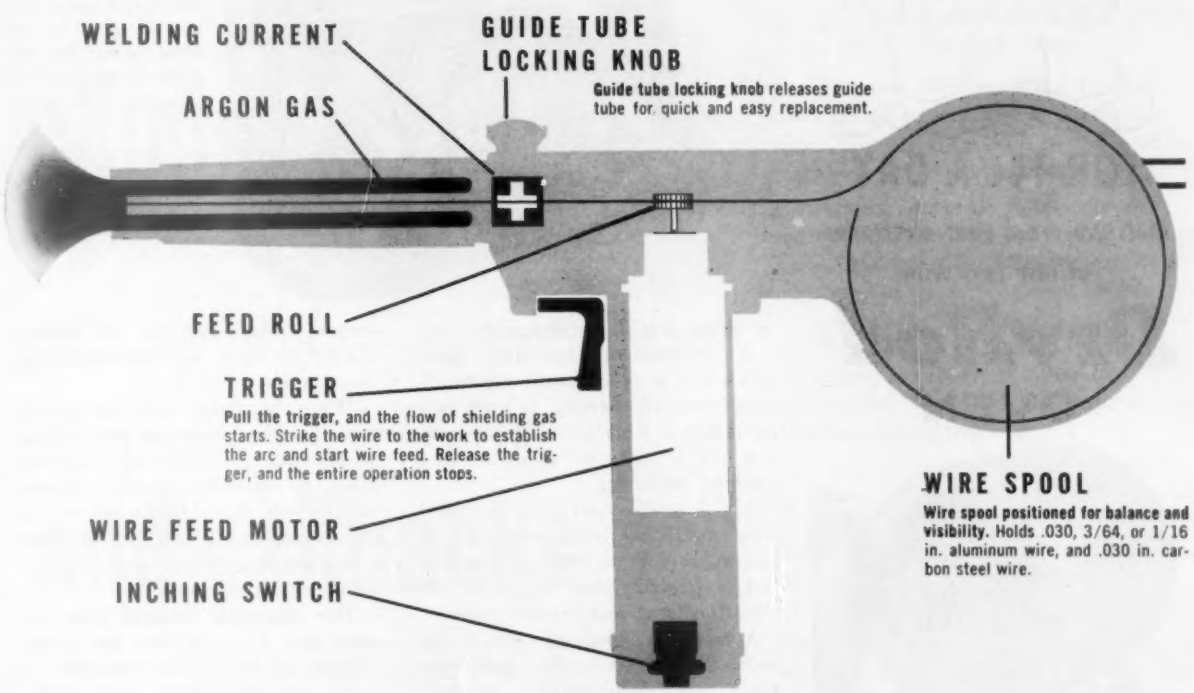
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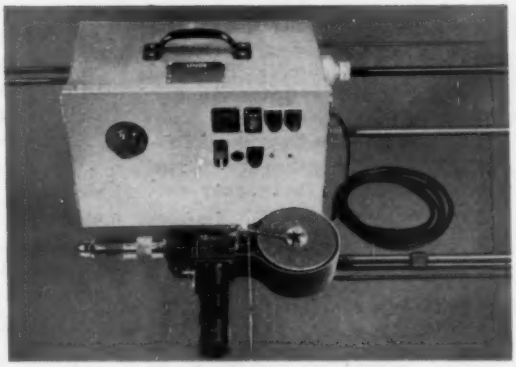

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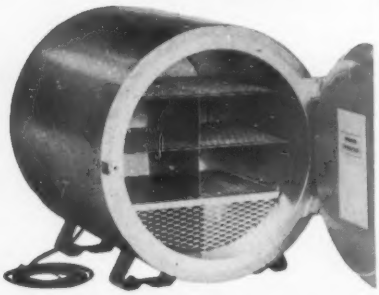

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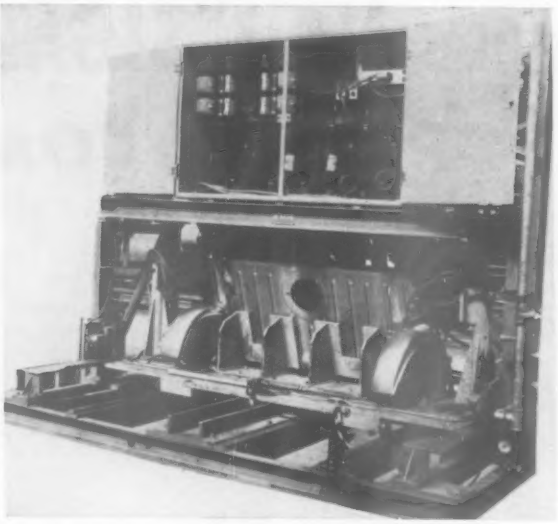


MULTI-spot welder joins rear seat panel to rear wheel arches of the Austin "baby" car with eight spot welds.

on either side of the assembly.

A pneumatically-operated table, which acts as an automatic ejector on completion of welding, is built into the machine, while the electronic control unit is the same as in the first machine described.

(3) A multi-spot welder equipped with two 75 kva transformers which tack-welds four seat-hinge brackets and two boxing-plate angles to the U-section front seat cross-member.

A manually operated table is indexed through six welding positions, which are pneumatically selected. Hinged lower electrode blocks, which flap into place inside the floor cross-member ends for attachment to the boxing plates, are cut away to allow two welding guns to descend vertically and make two series welds.

Two other guns make series welds in the cross member sides, welding current being carried across the U-section on the electrode block. Direct welding is used on the seat hinge brackets.

Three standard 2-stage timers, two of which control weld and forge times while the third acts as a spare, comprise the timing unit.

(4) A large multi-spot welder with a pneumatically-operated table and dieset carrying the floor pan, to which the front cross member and heel board are attached by means of 82 spot welds.

Two trolleys, one on either side, are automatically indexed to the welding position by air motors. Drive is by means of sprockets on the motor drive shafts, which engage chain lengths fitted between the trolley tracks to give a rack-and-pinion movement.

When the trolley (only one operating at a time) reaches the welding position, 82 guns descend simultaneously. A specially designed timing unit selects three banks of six 75 kva transformers and one of three transformers through a 4-sequence contactor arrangement.

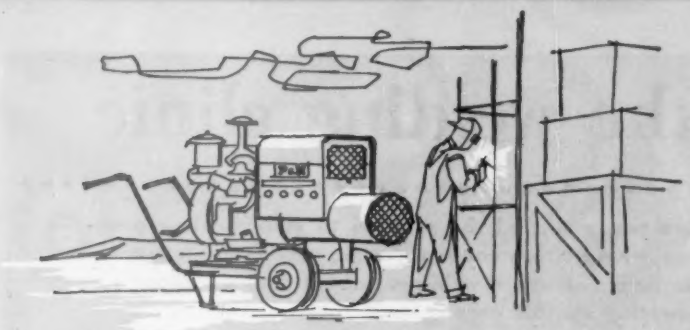
The electronic control unit ensures that no more than two transformers are fired at any one time.

(5) Another large spot welder with a welding trolley similar to the above welder for joining the heel board and seat cross-member to the floor pan in the curve of the transmission tunnel only.

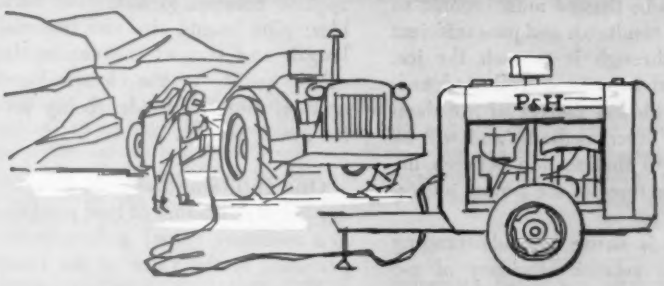
An air-motor is again used to index the trolley through six positions selected by an electro-pneumatic circuit. Welding guns are crossed to allow groups of four spot welds to be made in pairs inside the small-radius tunnel-curve. The guns are offset slightly to bring the spots exactly in line with stiffeners.

(6) A small multi-spot welder with a hand-operated table, which locates the four sections of the radiator, welds them together, indexing the assembly through four welding positions during the operation.

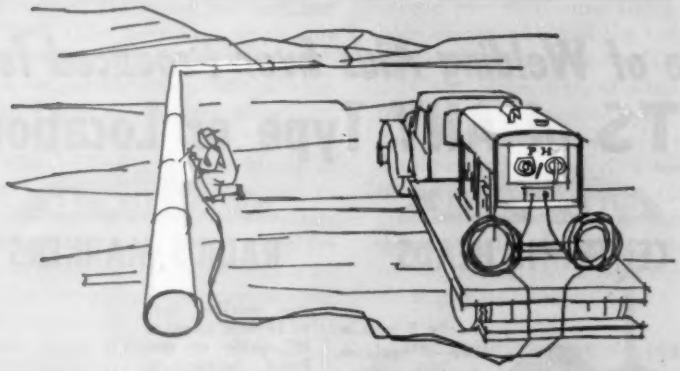
All welders were designed so that a maximum of 1,000 amp at 400 volts is drawn from the mains by sequence welding. Weld spots of 2-in. pitch are obtained by using tandem air-cylinders which, with a 90 psi air-line, produce electrode tip pressures of 400 psi.



eliminate rewelds



and callbacks



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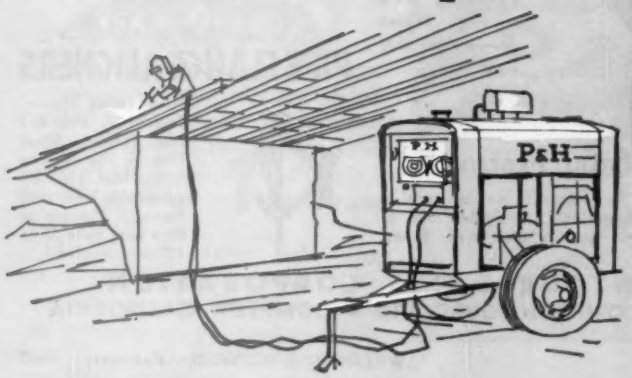

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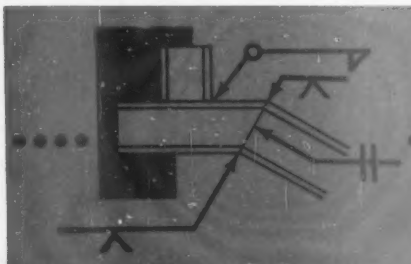

the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Electrical thawing of frozen water pipes

Question:

Could you give me some information on requirements and procedures for electrically thawing frozen water pipes?

Answer:

Thawing frozen water pipes by passing electrical current through them has long been recognized as a convenient and extremely useful method.

To produce heat in a pipe, the section to be thawed must become an electrical conductor and pass sufficient current through it to melt the ice. Electrical heat is distributed uniformly with less danger of fire damage than other methods, and will be confined to that section between the two connections to the power source.

There is some misunderstanding as to the relative efficiency of a-c versus d-c power for pipe thawing, according to Miller Electric Mfg. Co., Inc. Actually no definite rule can be applied because of numerous variables: pipe length, size and material; length and size of the connecting cable; quality of the electrical connection, and the welder being used for power supply.

One fundamental rule, however, applies: The amount of heat produced in a resistance (pipe) is directly proportional to the value of the resistance and is also directly porportional to the square of the current flowing through the resistance. Hence, frozen

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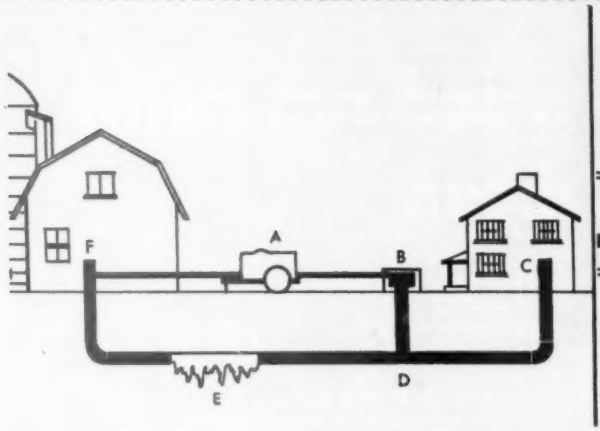
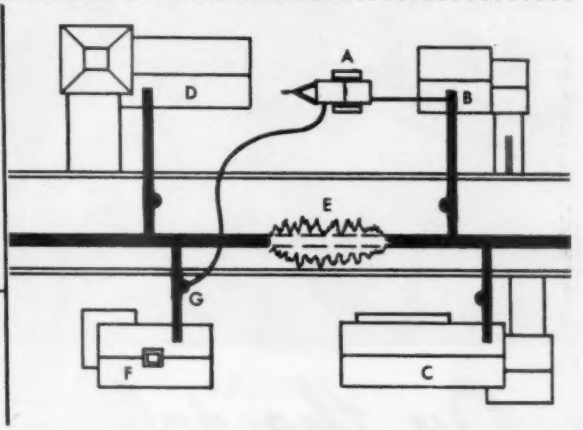


WATER was being supplied from the pump (B) to the house (C), but none to the barn (F). The welding generator (A) was connected between the two closest points, namely the pump and the water inlet to the barn. Thus, current was concentrated in the circuit from (B) to (D), through frozen pipe area (E) and to (F) and the ice was removed from the pipe.



CITY water main was frozen at (E) and houses (B) and (C) were not being supplied with water. Houses (D) and (F) were not affected by this frozen water main. The welding generator (A) was connected between point (B) at the water inlet to the house and point (G), the service curb stop to house (F). Current passing through the frozen pipe area (E) thawed the ice.

iron pipe thaws easier than copper tubing.

For a given section of pipe, it also pays to use as high a current as possible since doubling the current generates four times the heat; tripling the current, nine times the heat, etc.

These rules have been applicable to a-c or d-c. However, magnetic effects introduce complications when dealing with a-c and iron pipe.

The a-c (effective) resistance of iron pipe is generally higher than its resistance to d-c. Thus, an a-c welder can generally do a faster, better job thawing frozen iron pipes than a d-c welder supplying the same current. On copper or other non-magnetic metal pipes, there is no difference.

Furthermore, the a-c resistance of a magnetic-material pipe varies with frequency as well as with current strength. In general, effective resistance increases rapidly with an increase in frequency.

Thus, a welding generator producing a-c at frequencies greater than 60 cycles can be more effective in pipe thawing than power-line transformer or d-c generators. This general rule, however, must also be modified because of the length and size of pipes to be thawed.

Ideally, some current-indicating means (ammeter) should always be used when thawing pipe. Some welding generators come equipped with ammeters, but if not, an external one should be used. The clamp-on type is very convenient and effective, especially when using a-c.

The current, Miller Electric emphasizes, should not be allowed to exceed the maximum 100% duty cycle output rating of the welder to insure against the machine's failure.

If maximum output cannot be reached, means must be taken to reduce the effective resistance of the output circuit by including less pipe in the output circuit loop (moving cable connections closer together); or decreasing the resistance of the connecting cables (larger size cables as short as possible).

Determining pipe stoppage may be difficult, but once the frozen portion is located, lead connections from the generator should be placed to concentrate current at the points nearest the frozen section.

If in the city, help in locating the city main and curb stops can usually be obtained from the local water commissioner. If no convenient connections can be made, ground rods should be driven into the earth until good contact with the pipe is made, or digging into the pipe itself.

All connections must be secure and tight. A loose one will cause heating at the point of connection and reduce current flow in the pipe.

Cables from the generator should be kept as short as possible and of adequate size to handle the currents involved. For about 125 ft from the machine at 250 amp, a 3/0 cable can be used; 4/0 cable for 150 ft.

For longer distances or higher currents, two 3/0 or 4/0 cables can be run in parallel to make the connections. When using a-c, cable should never be coiled or laid near iron objects.

RECOMMENDED CABLE SIZES

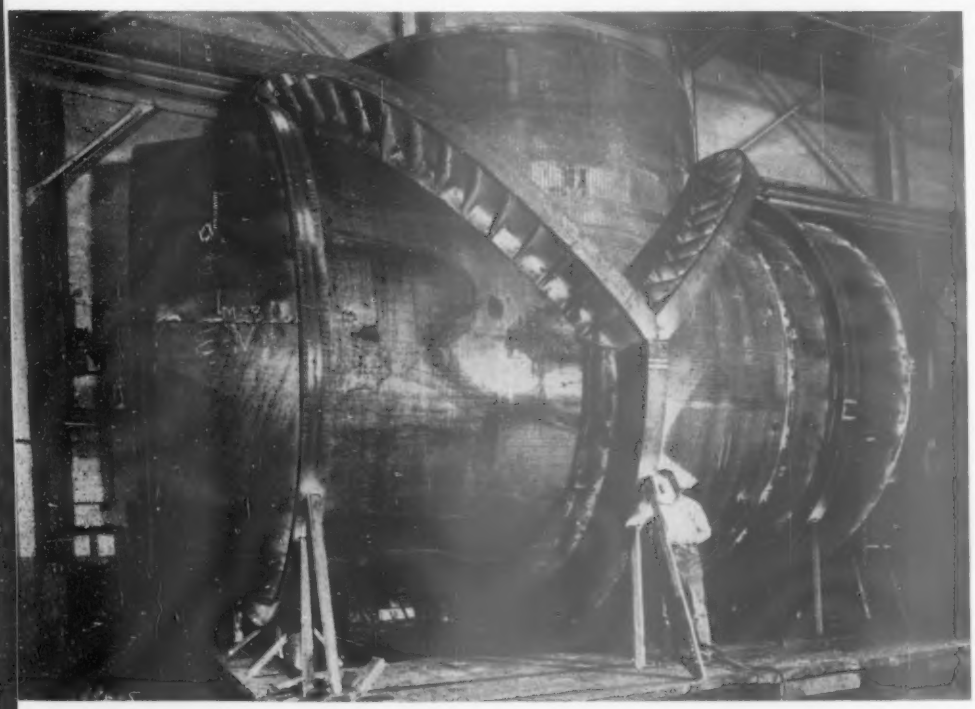
Distance in Feet from Welding Machine

Amps	50	75	100	125	150	175	200	225	250	300	350	400
100	2	2	2	2	1	1/0	1/0	2/0	2/0	3/0	4/0	4/0
150	2	2	1	1/0	2/0	3/0	3/0	4/0	4/0	4/0	2-2/0	2-3/0
200	2	1	1/0	2/0	3/0	4/0	4/0	4/0	2-2/0	2-3/0	2-3/0	2-4/0
250	2	1/0	2/0	3/0	4/0	4/0	2-2/0	2-2/0	2-3/0	2-3/0		
300	1	2/0	3/0	4/0	4/0	2-2/0	2-3/0	2-3/0	2-4/0			
350	1/0	2/0	4/0	4/0	2-2/0	2-3/0	2-3/0					
400	1/0	3/0	4/0	2-2/0	2-3/0	2-3/0						

CROSS braces (10-gage cold-rolled steel channels) are being spot welded on a 60 x 20-in. bottom pan for a 60-ton water cooling tower in Halstead & Mitchell's Zelienople, Pa., plant. By using wider sheet steel for housings of the tower, condensers, and evaporators, the company has reduced fabricating costs and simplified design and fabrication techniques. Decreased welding requirements and greatly lowered scrap losses produced most of the saving. Pan is fabricated of two 72-in.-wide, 12-gage cold-rolled steel sheets, supplied by Jones & Laughlin Steel Corp., Pittsburgh. A square is cut from each corner of the sheet, and the walls are formed by bending the four sides on a press brake. Only 132 in. of welding are needed to close the corner seams. This compares with 300 in. of welding previously required. Use of the 72-in. sheet ended most of the piecing together of unit panels and the extra care required to produce smooth welded joints.

On the job...

OPERATOR begins cutting 1-in.-thick stainless steel at Bergren Steel Corp., Oakland, Calif. Operation was part of construction by Berkeley Steel Construction Co., Inc., Berkeley, Calif., of a specially designed stainless fixture weighing 9,000 lb. Specifications, with urgent delivery required, called for fabrication of type 347 steel up to 2 in. thick. Tig cutting process was used for the work. A water-cooled torch mounted on Linde Oxweld CM-45 machine carriage was used to totally mechanize the operation. Two hundred linear feet of cut was made, including both straight-edge and 45-deg bevel cuts. Cutting speed averaged 12 in. per minute, and approximately 32 man hours were consumed in the job. Completed assembly, including stress relieving and machine work, was delivered 10 days after receipt of the order.



PRECISE mathematical calculations by engineers of the Steelweld Div., R. C. Mahon Co., Detroit, created this mammoth steel header pipe for Detroit's new raw water booster pumping station. The giant "pipe" is 90-ft long and 14-ft in diameter. Varying thicknesses of steel joined by automatic submerged-arc welding was involved in production.

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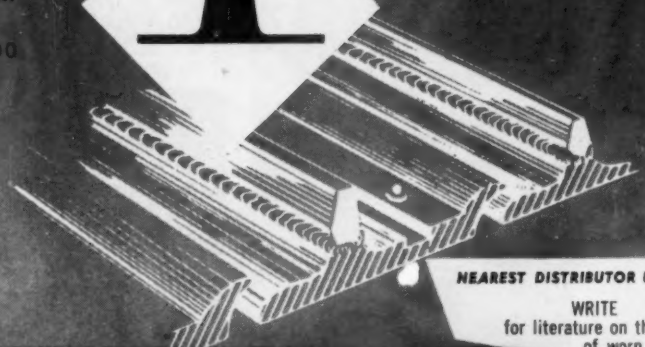

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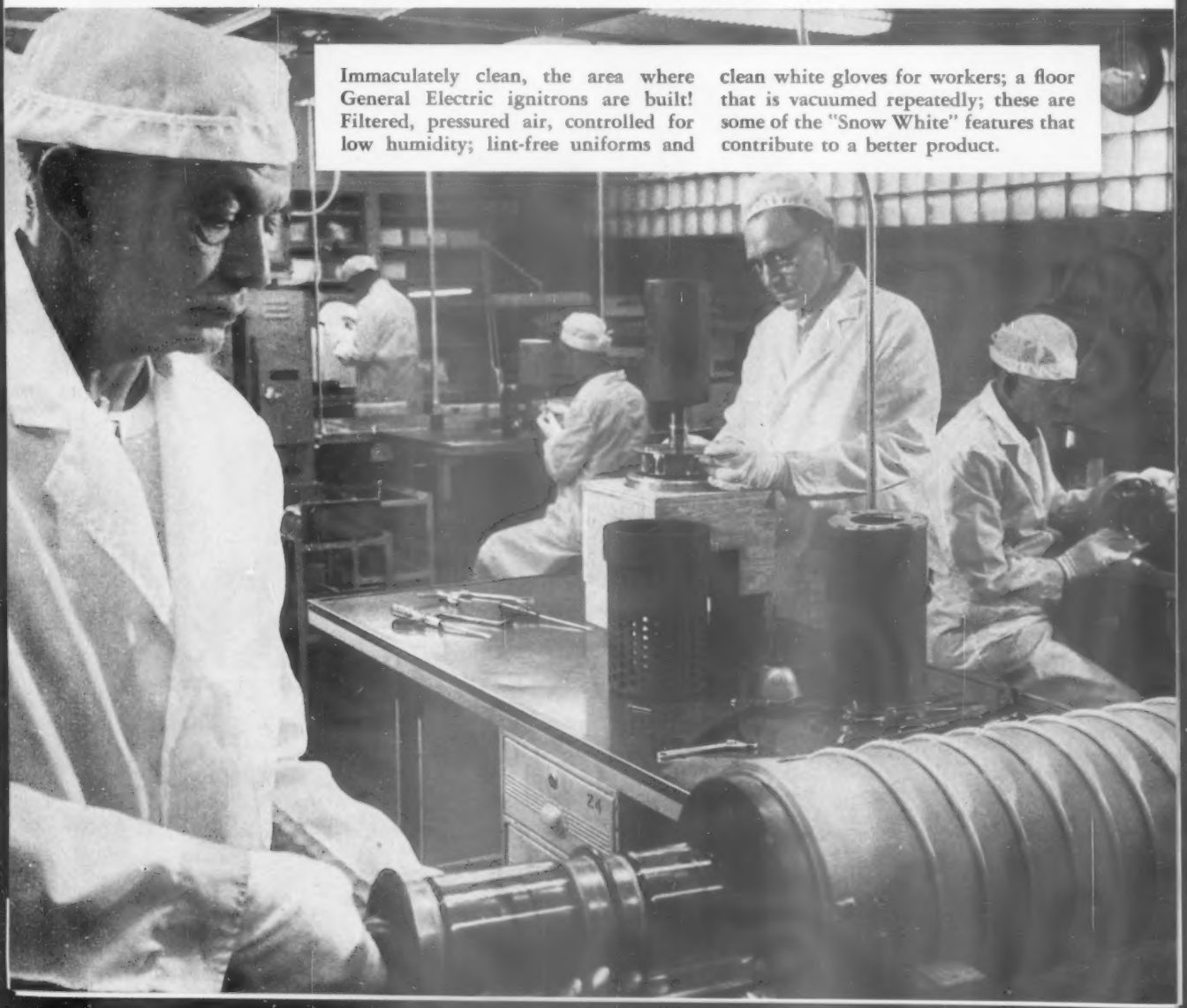
The tiny deposits of rust that work harm inside other metal tubes, will not form in the dry air and spotless surroundings in which G-E ignitrons are assembled. These premium-quality tubes are built for utmost dependability, maximum service life. They keep your production humming. Phone your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*



Immaculately clean, the area where General Electric ignitrons are built! Filtered, pressured air, controlled for low humidity; lint-free uniforms and clean white gloves for workers; a floor that is vacuumed repeatedly; these are some of the “Snow White” features that contribute to a better product.

# of G-E Ignitrons! Output Speeded!

White gloves keep moisture and contamination from parts like this G-E ignitor point which is being micro-inspected. The parts first are baked in hydrogen furnaces to remove all impurities; then are delivered to the inspection and assembly area in sealed plastic bags.

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NL-1051	5551-A	NL-1052	AX-5552-A	NL-1053	GL-5553-A
NL-1051-A	AX-5551-A	NL-1052-A	AX-5552/651	NL-1053-A	GL-5553/FG-258-A
NL-5551-A	AX-5551/652	NL-5552	WT-210-0072	WL-5553-B	AX-5553-B
WL-5551/652	WT-210-0149	WL-5552/651	WT-210-0157	WL-5553-A	AX-5553/655
WL-652/657	WT-210-0071	WL-651/656	GL-5552/FG-235-A	WL-5553/655	WT-210-0073
WL-5551-A	WT-210-0156	WL-5552-A	5552	WL-655/658	FG-258-A
5551	GL-5551/FG-271	FG-235-A	5552-A	5553	5553-A
	FG-271				5553-B

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In the shadow of the Midwest's steel mecca . . .

A Chicago high school is producing trained weldors for industry

by **Ken Rhodie**

WITHIN SHOUTING DISTANCE of the great steel-making center of East Chicago is a sprawling, 23 acre site upon which sits an institution devoted to preparing youngsters for an industrial trade.

The institution is Chicago Vocational High School. It is located on the city's far south side, and is governed by its board of education.

Twenty-one shop courses are offered the more than 3,000 male students, and at present approximately 100 students are engaged in learning the fundamentals and techniques of arc and gas welding. The students spend 15 hours a week in the welding shops, and are taken through a course of increasing complexity over a two-year period.

In addition to the shop courses, the students must also meet the board of education's academic requirements.

Upon graduation, all welding students have the ability to handle jobs in heavy industry. Some are ready to be fully certified weldors, others are capable of being tackers, helpers, etc., but have the potential to be full-fledged weldors in the future.

Most of the graduates go from CVS into heavy industry, applying the trade they have mastered. Some of the students go on to college, many of them returning to teach a trade in the shops of Chicago or other schools.

The school has a placement counsellor who directs students to leads, but the school itself does not find jobs for graduates. Occasionally, manufacturers themselves will contact the school in search of talented help.

Bright, large, well-equipped welding shops help the school's two instructors train students. The arc-welding shop has 24 welders, 2 oxyacetylene cutting stations, one oxograph cutting machine, a floor grinder, power saw, drill press, four acetylene welding stations and a metal shear. The gas shop has 24 torch stations, a sheet metal roll and tube bender.

During one school year, the prospective weldors of CVS use close to 6 tons of electrodes making practice welds on more than ten tons of steel.

Students are instructed in manual metal arc and oxy-acetylene welding only, but the theory behind new developments are discussed.

When students enter CVS, they go through an exploratory two-year program during which they are exposed to as many shops of their choosing as possible. In this way, students sample the various trades to see in which field they are most interested and have the most capability.

When the student reaches his third year of high school, he chooses the trade on which he will concentrate in his final two years.

This is true, too, of the weldor. For him, the course is divided between arc and gas welding. During the course, shop work is supplemented by class discussion, theory, movies showing welding at work, and the reading of certain texts.

If the student spends his first year of specialization in the arc welding shop, he reviews fundamentals of elec-

INSTRUCTOR Andrew Kuban (right) watches as Phil Lake makes an oxyacetylene weld on an aluminum pressure vessel. Joseph Cannon and Fred Massaro assist.

GENE Drzewiecki practices oxyacetylene technique at welding station in gas shop.

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As above except:
Rated Capacity:
Continuous duty cycle: 130 Amp.
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MODEL 3220 (Angle)
Same as 3110 except:
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Handle diameter: 1 inch.
Electrode length: 3 inches.

MODEL 3440 (Angle)
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Name.....
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WILLIAM Casey arc welds pipe using an E6010 electrode. Upon graduation from CVS, he will be an apprentice pipe fitter.

EVERY year Ford Motor Co. sponsors Ford Industrial Arts Contest. Above, gas welding instructor John Gassick (left) and Ray Tolentino inspect one entry for contest, an all-welded wrought iron charcoal broiler and spit. Other items included lawn table and chairs and record holder.

HERE, Michael Prindiville uses an oxyacetylene torch to cut an angle iron as Lewis Gade holds. Four lb of acetylene and 20 lb of oxygen are being used.

tricity, welding techniques and basic metallurgy, all of which he has already been exposed to.

In the shop, he is taught basic machine settings, the difference between input and output power, a-c and d-c currents and selenium rectifiers and motor generator sets. Welding exercises are followed so the boys can acquaint themselves with the equipment and its manipulation.

Following the classroom review and shop fundamentals students learn the basics of all position welding.

Those students who spend the first year in the gas shop review techniques also, and learn about cylinders and other equipment. Following this, there is an introduction to metals, design, layout, fabrication and all position welding.

In the second half of the third year, layout and fabrication in the arc welding shops is gone into in detail. Also, oxyacetylene cutting—free-hand, machine, and guide-bar methods—are taught. This is followed by work in fit-up, pipe-fit-up and tube bending, and theory and application of preheat and stress relief.

In the acetylene shops, all position welding on steel and brazing of dissimilar metals is taught. The boys join cast iron to steel, brass to steel, malleable iron to cast iron or steel, drill rod to steel and copper to brass. All related operations—cleaning, metal, pre-heat, fluxing—are also covered.

Arc welding instruction in the first half of the fourth year covers horizontal and flat welding lap and butt joints. Fillet welds, deep groove welding using iron powder electrodes, and flat butting and horizontal butting of pipe are also taught.

In theory, students cover the metallurgy of stringer versus weave welds, as regards to stress and strain in welds, are given a general picture of weld qualification tests and the methods of testing, and study electrode classifications and comparison charts. Also detailed are characteristics of voltage and amperage as regards to the arc.

In the gas shops, fusion of dissimilar metals and techniques of procedure are of primary concern. Silver solder, and other low melting non-ferrous weld operations are covered.

Also detailed in this semester are the care and maintenance of welding equipment, metallurgy applied to gas welding and complete analysis of fluxes.

The last semester in arc welding is devoted to all overhead position welding of various joints, and subjecting students to simulated weldor qualification tests patterned after Hartford specifications. Students also arc weld sheet metal.

In the classroom arc welding symbols are covered, as are advanced machine design, new techniques and innovations.

In the gas shop, tests are given and the maintenance of regulator, torche, hose and other equipment are taught.

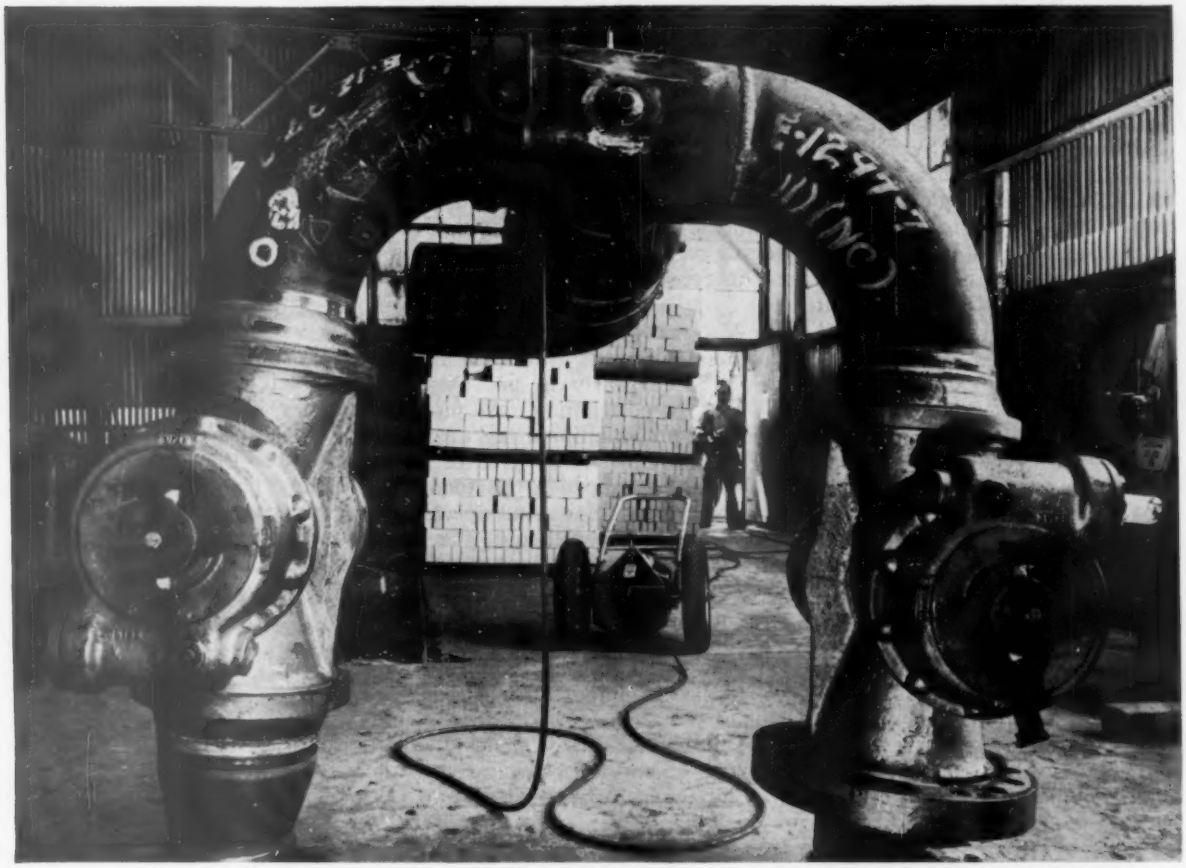
Theory is concerned with chemical changes due to atmosphere, studying the charactertistics of oxygen, hydrogen, argon and carbon dioxide, safe working pressure, and prevention of accidents through misuse or improper handling of equipment.

Andrew Kuban, arc welding instructor, says that once fundamentals are understood, a student only learns by practicing the various welding operations. Students practice in two ways—by repairing broken school equipment, and by doing projects of their own design, such as wrought iron book cases, tables, etc.

Kuban emphasizes the importance of the repair operations in the shops. He explains that when a student is given a job, he must first draw the object, show where the damage is, then design the proper weld to fix it. He must also choose electrodes, and decide on pre and post-weld operations. Though everything is under supervision, the students must do almost all the planning themselves.

A cracked motor block was once brought to the shop for repair. Instead of building up the hole, it was decided to patch it. An oxyacetylene torch was used to cut out the piece, and a nickel electrode helped to weld a steel patch in the cast iron block.

About 10% of each semester is devoted to working on what Kuban calls "sweeteners"—practical objects made through the use of welding. He says such functional welding creates student interest because it gives him a chance to build items utilizing his new-found skills.



The entire circumference of the left hand weldment at the Tee fitting of this pipe assembly is being radiographed in a single exposure with a Model 50 Multitron. The unit can handle any isotope suitable for gamma radiography . . . and up to four separate sources can be contained in the same machine. A wide variety of exposures can be made—internal, panoramic and beam. Model 50 travels with ease anywhere in plant or field, requires no external power.

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News shorts . . .

Stronger alloys, designed to more exact specifications, may be the result of research reported by a **Battelle Memorial Institute** scientist. New findings on the strength of experimental aluminum-copper alloys, described by Dr. Ervin E. Underwood of the institute's Columbus, Ohio, research center, may apply to more complex alloys. The institute's investigations disclosed that although increased spacing of the fine metallic particles dispersed throughout the alloys means increased weakness, this trend reverses itself at a certain point.

An automatic control system designed by **Westinghouse Electric Corp.**, Pittsburgh, is currently in use at the **Consolidated Western Steel Co.**, Provo, Utah, for positioning steel pipe preparatory to welding. The system sequences the pipe-manipulating devices so that the pipe stops at desired welding stations, providing greater convenience for the weldors and increased storage capacity in the plant. . . . Rising present and projected sales of welding machines and special d-c power supplies have prompted **A. O. Smith Corp.**, Milwaukee, to increase manufacturing floor space at its welding products division plant at Elkhorn, Wisc.

Argonne National Laboratories, Lemont, Ill., has signed contracts for the purchase of a 10 million electron volt tandem Van de Graaf particle accelerator, to be supplied by the **High Voltage Engineer Corp.**, Burlington, Mass. The accelerator is considered to be an important research tool needed for further study of the nucleus of the atom. . . . **All-State Welding Alloys Co.**, White Plains, N. Y., is expanding its Los Angeles facilities. The company has moved into a modern plant and offices, more than doubling the space previously available for its Pacific operations.

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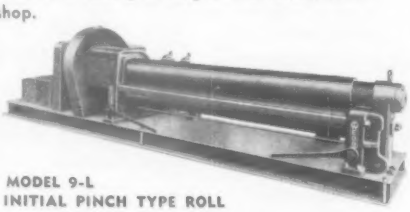
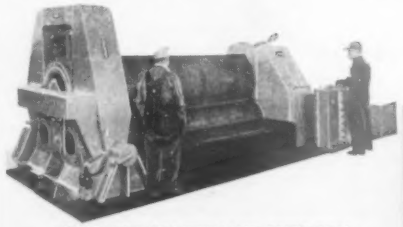


MODEL 9-L
INITIAL PINCH TYPE ROLL



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HANDY & HARMAN SILVER BRAZING Permits Manufacturer to Guarantee Underwater Air Regulator For Life

Perhaps the most vital component of a skin diver's equipment, this Viking Air Regulator, manufactured by Christensen Tool & Engineering Company, Norwalk, Connecticut, is structurally guaranteed for life. It must, under all conditions, be absolutely leaktight. The manufacturer's guarantee is a relatively recent achievement—through the high-strength help of silver alloy brazing with Handy & Harman EASY-FLO 45 and HANDY FLUX.

Over and above the unreserved dependability of brazed joints, the brazing method itself has saved the company considerable time, money and material in the production of the Viking Air Regulator. Brazing's simplicity is interestingly illustrated in this case by this company's requirement that assemblers and testers of the Viking must be skin divers themselves.

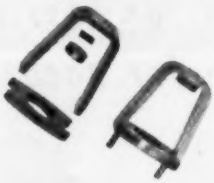
Almost invariably, silver brazing effects economies and brings advantages to whatever part, product or assembly it is applied. True, air regulators are few and far between, but the point is that they are *metal products, made of a number of different metal components.*

And that's the phrase that covers brazing's great adaptability. To give you a good idea of how you can put brazing to work, we'd like to send you Bulletin 20—it covers the basics of brazing and it may very easily solve your metal-joining problems. Handy & Harman, 82 Fulton Street, New York 38, N. Y.

Here, in "serial" form is how the guarantee is "brazed" into the Viking:

1. TANK HOUSING—Initially, this component was mechanically joined and made "airtight" by means of sealants. Now, brazing eliminates 8 holes, 4 tapping operations, 4 screws and 3 assembly operations.

5. Shown here are the finished Viking components before and after assembling. —Brazing by Specialty Brazing Laboratories, Riverside, Connecticut.



3. YOKE—This is assembled from stampings instead of castings, which were previously used. With brazing, no secondary finishing operations are required. Further, the part is stronger and lighter, and savings on material and labor on this component alone add up to 28%.

2. FORK ASSEMBLY—There are five separate brazed joints, done with hand torch and hand-fed wire. Brazing eliminates one tapped hole, a lock washer and a spacer, plus the fact that positive alignment is now guaranteed.

4. PISTON—This is the most important single element of the Viking. It regulates flow of oxygen from cylinder to mouthpiece; from 300 lbs. pressure to normal breathing. Without brazing, this part could not be made.

Your No. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

DISTRIBUTORS IN PRINCIPAL CITIES

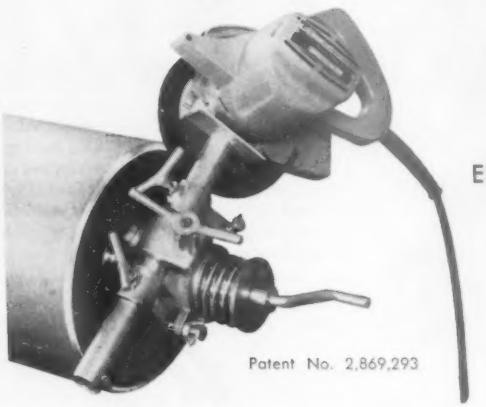
COMING IN NOVEMBER! *New Handy & Harman Brazing Correspondence Course. Simple self-study data on all phases of brazing. Send for details to Dept. BC.*

News shorts . . . continued

Federal Machine and Welder Co., Warren, Ohio, has experienced a marked improvement in new orders for equipment during the past few months, president J. R. Barefoot stated in the company's annual report. The report indicated that the low volume of net sales for the fiscal year ended September 30—$4,709,394—was indicative of the depressed condition of the industry during that period. . . . **Hobart Bros. Co.**, Troy, Ohio, has produced a film telling the story of basic factors important for correct electrode selection. The 25-minute 16-mm full color movie outlines a step-by-step procedure covering base metal identification, welding currents, welding positions, joint design and fit-up, production efficiency, and related topics. . . . **Bateman Foundry & Machine Co.**, Mineral Wells, Tex., is observing its 50th anniversary. William Bateman started business in 1909 at Boonville, Ind.

A plant producing high purity liquid oxygen has been placed in stream at Dallas by **National Cylinder Gas Div., Chemetron Corp.** The facility also produces liquid nitrogen and argon. . . . **Balteau Electric Corp.**, Stamford, Conn., has met U. S. Navy Bureau of Ships specifications for its radio-graphic equipment. Part of the testing involved raising X-ray tube housing two feet and dropping it on a concrete slab (see photo). The machine was then operated on a cycle of two minutes on, five minutes off for two hours. . . . **Earlbeck & Landrum Inc.**, Baltimore, has changed its name to **Earlbeck Welding Supplies, Inc.** Purpose of the change is to identify the firm more closely with welding in fabrication, construction, and maintenance.

• *for fast cleaning of pipe cuts . . .*
• *for accurate placing of lands on pipe bevels . . .*



H&M "BEVEL-LAND" GRINDER

LIGHTWEIGHT! EASY TO OPERATE!

Eliminates Handwork on all Types of Pipe from 6" to 30"

The new H&M "BEVEL-LAND" GRINDER uses an electric or airpowered grinder to prepare pipe for welding by cleaning and smoothing pipe cuts and putting the land on bevels. The GRINDER may be placed in the pipe and in operation in a few seconds. A simple adjustment of the angle of the grinding head is all that is required to change the machine from the cleaning to the land position. The machine is available in two models: one for 6" to 12" and one for 14" to 30" pipe.

Write for Complete catalog of famous H&M equipment

- Pipe Cutting and Beveling Machines for pipe from 1½" to 36"
- Shape Cutter
- Out-of-Round
- Flexible Shaft
- Motorized Units
- Boxes • Pipe Dollies • Clamps • Tongs

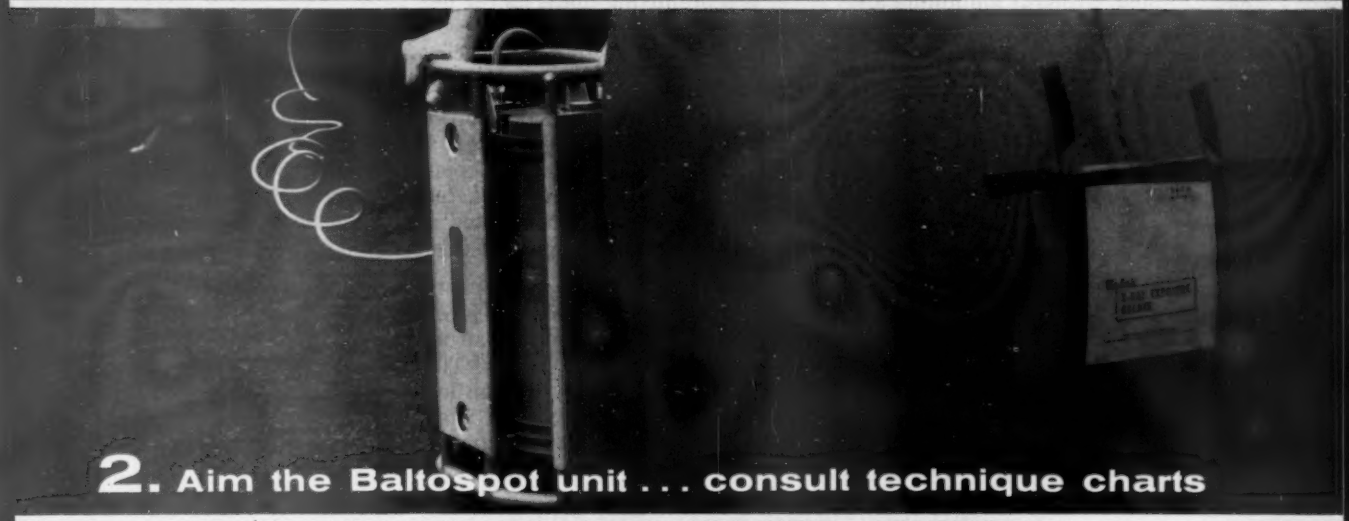
H&M PIPE BEVELING MACHINE CO.

311 EAST THIRD ST. Diamond 3-0241

TULSA, OKLAHOMA

Trademark Registered

1. Attach the film holder



2. Aim the Baltospot unit . . . consult technique charts

3. Set the controls . . . press the button!

YOU'VE JUST MADE A WELD X-RAY!

Taking repetitive or field X-rays is a 1-2-3 operation with this Baltospot portable unit—can be learned in less than a day. You simply carry the unit to the job, X-ray the weld, and develop the film—all in a matter of minutes.

And don't forget—X-ray weld inspection is a real cost-cutter, too (77% savings on inspection were recently reported by a prominent tank fabricator).

For the whole story, contact your nearby Westinghouse X-ray sales representative. Or write: Westinghouse Electric Corporation, X-ray Department, 2519 Wilkens Avenue, Baltimore, Maryland. J-08378

YOU CAN BE SURE...IF IT'S

Westinghouse

News shorts . . . continued

Three firms have made available printed information on their products. **Nuclear Systems Division of Budd Co.,** Philadelphia, has issued a new 12-page brochure detailing its capabilities to provide radiation sources for irradiation research, radiography, and teletherapy . . . **Miller Electric Mfg. Co.,** Appleton, Wisc. recently completed a 48-page booklet, "The Miller Electric Story" issued as a 30th anniversary piece . . . **Grinding Wheel Institute,** Cleveland, is making available a wall chart listing ten "do's" and ten "don'ts" for grinding wheel operator safety. Write directly to the firm if you're interested.

New Jersey section of **AWS** will hold a two-day Welding Educational Seminar March 16-17 at the Essex House in Newark. Top welding authorities will discuss up-to-the-minute welding techniques and joining methods. . . . 5086 wrought aluminum alloy sheet is a promising material for use as skin for ballistic missiles, recent Army research showed. The study was conducted to determine the weldability of the 5086 alloy to selected cast aluminum alloys.

A new titanium alloy has been developed in the **Research Div. of New York University's College of Engineering.** It contains 6% aluminum, 6% vanadium, 2% tin, 0.5% iron, 0.25% copper, and 85.25% titanium. **Dr. Harold Margolin** and **Paul Farrar** conducted the research. . . . **Dunwoody Institute,** Minneapolis, recently conducted a welding show in conjunction with the northwest section of American Welding Society.

Four new training films have been released by the **National Safety Council.** Described as a "fresh, realistic solution to the ever-present problem of communication," the films use everyday supervisor-worker situations, plus a combination of live-action photography and animation. The Council has also published the fourth edition of its "Accident Prevention Manual for Industrial Operations." Based on opinions of safety men from nearly 7,000 firms covering every U. S. industry, the manual contains more than 500 illustrations and 1,542 pages of current data on industrial safety.

Pipeline News

The Federal Power Commission has authorized construction and operation of a 22.4 mile pipeline by the Mountain Fuel Supply Co., Salt Lake City. The line will extend northeast from Coalville, Utah into Unitah County, Wyo.

Columbia Gulf Transmission Co., Houston, has received FPC authorization to construct 41.1 miles of 24-in pipeline loop at an estimated cost of $3,916,000. The loop will begin at the company's Erath Junction in Vermillion Parish, La., and extend southeasterly to a junction with its 12-in Lake Sand gathering line in St. Mary Parish, La.

FPC presiding examiner Richard N. Ivins has filed a decision, subject to Commission review, authorizing three independent producers to sell natural gas to El Paso Natural Gas Co., El Paso. The producers are Continental Oil Co., Houston; Magnolia Petroleum Co., Dallas; and Western Natural Gas Co., Houston, an affiliate of El Paso.

Ohio Fuel Gas Co., Columbus, has received FPC permission to install new pipeline facilities designed to provide more effective utilization of the company's Pavonia storage field capacity in Richard County, Ohio. Cost of the project is estimated at $865,000.

A decision authorizing five independent producers to sell gas to Cimmarron Transmission Co., Tulsa, was recently filed by the FPC. Cimmarron is in turn authorized to sell gas to the Natural Gas Pipeline Co. of America, Chicago. Natural will build 29 miles of 10-inch line at a cost of $772,000 to enable it to take the gas into its system. Producers who will make the sales are Pacific Coal and Oil Co., Texaco, Inc., Sinclair Oil & Gas Co., Shell Oil Co., and George E. Cameron, Inc.

Midwestern Gas Transmission Co., Houston, has been authorized by the FPC to build a new $52,277,000 pipeline system to import 204,000,000 cu ft of natural gas per day from Canada into the north central United States for consumption in North Dakota, Minnesota, Michigan, and Wisconsin. Midwestern's 24-inch main line from the Canadian border to Marshfield, Wis. will be 504 miles long. The company will also build about 56 miles of laterals and two compressor stations. System capacity will be 221,400,000 cu ft daily.

Southern Natural Gas Co., Birmingham, has received FPC approval to construct pipeline facilities costing approximately $52,000,000. The FPC also authorized South Georgia Natural Gas Co., Thomasville, Ga. to build facilities at a cost of nearly $2,000,000 to provide increased service to 15 existing customers, and new service to six communities and three industrial consumers.

FPC authorization has been granted to Transwestern Pipeline Co., Houston, to construct a new $191,700,000 system. The company intends to supply 300 million cu ft of natural gas daily to markets in Southern California. At the same time, the Commission granted certificates to 14 independent producers and one pipeline company authorizing them to sell gas to Transwestern but attached conditions reducing the initial prices on several of the proposed sales.

"April showers bring May flowers" and April showers opportunities galore

Advertising in the April issue of WELDING ENGINEER will bring year around results because—

April is National Welded Products Month*

A month devoted to welding's promotion

April is Welding Show Month*

The 8th annual welding show will be held in Los Angeles' Great Western Exhibit Center, April 26-28

April for WE is something special

From its front cover throughout the issue WELDING ENGINEER will reach those manufacturers, purchasing agents and distributors that YOU want reached

*Originated or proposed by WE

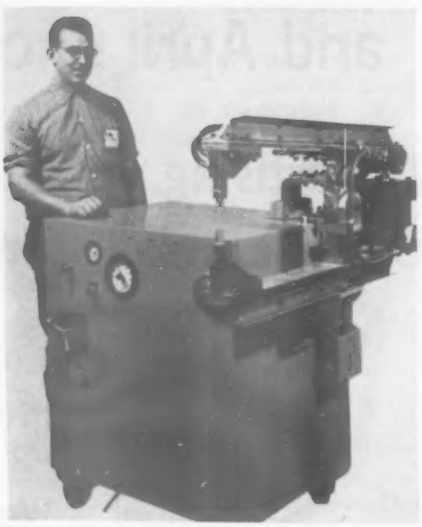
To get your message to more than 25,000 of the most important welding people, act now to reserve space in the all-important April issue of WE. Closing date, March 1

Welding Engineer
P.O. Box 28
Morton Grove, Ill.

For another result-getting edition . . .

remember *WE's* Mid-June FACT FILE—the most complete directory published for the welding industry. This buyer's guide is used throughout the year, and it sells throughout the year. Forms close May 20; issue is mailed June 15

new products . . . . . use card on page 97



A-c welding outfit

High-output, low-cost a-c welding unit is designed for auto repair, farm, industrial maintenance, and home workshop requirements. Welds metal up to ¼-in. thick with good penetration. With an auxiliary arc torch, outfit can also be used for brazing, soldering, heating and bending on all ferrous and non-ferrous metals. Weight is 40 lb; welding current range is 20-95 amp. *Metal and Thermit Corp.*

Circle No. 1

Radiography

New line of custom equipment for the handling and utilization of very strong radioactive sources includes industrial gamma radiography machines for radiographic inspection; gamma irradiators for studying the chemical and physical effects of gamma radiation on various raw materials, products, and processes; special radiation monitoring devices designed for use with the above equipment. *Radiation Engineered Services.*

Circle No. 2

Portable pyrometer

Portable pyrometer measures temperature between minus 40 F and 200 F. This is accomplished by means of two scales or arcs in order to provide one degree per scale division and therefore readability to at least the nearest one-half degree. Selection of interchangeable thermocouples makes instrument versatile. *Illinois Testing Laboratories, Inc.*

Circle No. 3

Tracer welding

Follower tracer welding system permits joining of parts having untrimmed, straight line or contour weld line edges in a continuous automated welding operation. In the system, the basic welding head carriage follows the design contour of the parts by means of contour cams built into the machine. Mechanical probe connected to the tracer system follows the actual weld contour. Difference or "error" between the contour and the actual contour is transmitted to a memory unit, and from there to the torch. Machine has an error following rate of 3/16 in. per in. of travel. Total error compensation is plus-minus ¼ in. design, plus-minus 5/16 in. maximum. *Expert Welding Machine Co.*

Circle No. 4

Brazing alloys

New line of self-fluxing brazing alloys contains a vaporizing flux which permits work with difficult alloys such as aluminum and titanium bearing metals in hydrogen and argon atmospheres. Addition of the flux does not change alloys' specifications or properties and has no effect on joint properties. Company states the flux will attack no known base metal and leaves no residue. *Wall Colmonoy Corp.*

Circle No. 5

Welding gun

Air-cooled Mig (metal inert-gas) welding gun can accommodate hard wires ranging from .035 in. through 3/32 in. fed from conventional wire feeders. Gun is equipped with a lever type trigger and goose-neck assembly for easy welding in hard-to-reach areas. Number of cable connections has been reduced by combining both the power cables and the wire casing. Designated model AH60-B, the gun has a continuous duty rating of 600 amp d-c when using "buried arc" CO_2 techniques. *Air Reduction Co., Inc.*

Circle No. 6

Vertical sander

Medium-duty vertical sander combines high torque and lightweight construction. Six basic models range from 1,850 to 8,500 rpm and expand to 12 with a choice of thumb flip or safety throttle. All models weigh less than six lb, and all bear a spindle thread of ⅝-in.-11 and posses a fully adjustable dead handle. Six models, intended for operation at 7,200 rpm or more, use 5-in. pads; all others are 7-in. *Buckeye Tools Corp.*

Circle No. 7

Silicon diode welder

Silicon diode unit used in the welding of steel, aluminum, brass, and aluminum die cast material, utilizes 3-phase balanced power supply with the usual very low power demand common to direct current weld circuits. Gun is constructed to be easily converted to a d-c portable by the addition of a hanger and water cooled cables. Co-designed with Robotron Corp. and International Rectifier Corp. *Helfrecht Machine Co.*

Circle No. 8

Thawing unit

Transformer type pipe thawing unit operates on ordinary house current of 110 or 220 volts, single phase, 50 or 60 cycles, a-c, and can be carried by one man. Output rating of the unit is 300 amp, 10 volts on 100% duty cycle and there are no electrical connections between the power line and the output terminals, making it as safe to operate as a household appliance. *Hobart Bros. Co.*

Circle No. 9

Seam tracer

Welding seam tracer, an electronic control system, automatically causes a welder to follow the crack to be welded. Welding head follows the crack rather than a prescribed course, which may or may not be right. Any deviation of the wire from the crack results in an error signal. Signal is applied to an electronic device which causes the torch to move in a direction such as to nullify the signal, thus moving the torch back to the seam. *The Weldma Co.*

Circle No. 10

Sensitive film

Accurate reporting of radiation doses as low as one milliroentgen is possible with new sensitive film. New IBM computing system also saves tallying time for subscribers and increases convenience for report filing. *Nuclear-Chicago Corp.*

Circle No. 11

180-Amp welder

Putting the convenience of immediate arc welding repair in every metal-working area is purpose of new design 180-amp welder. Electrodes from smallest 3/16 in. can be used to weld from 20 gage to ½ in. or thicker plate. Operation on 220-volt, single phase power supply combined with compact, lightweight construction permits easy movement of the welder. Voltage input adjustment insures full output performance under all power supply conditions. *Lincoln Electric Co.*

Circle No. 12

Aluminum fittings

High strength aluminum alloy light wall fittings and flanges are available in ½-in. to 4-in. pipe sizes. Advantages of light weight, corrosion resistance, low cost and long life emphasized by manufacturer. Fittings' long tangents permit easy alignment and fabrication of completely flanged elbows, returns, tees and crosses. Joining is easily accomplished by butt or fillet welding or brazing using an aligning connector, by use of stub end and backup flange, and by the "rolled-in" flange assembly, where the fitting is cold-expanded into an aluminum insert and the flange rotates freely about the insert for easy bolt alignment. *Tube Turns, Div., Chemetron Corp.*

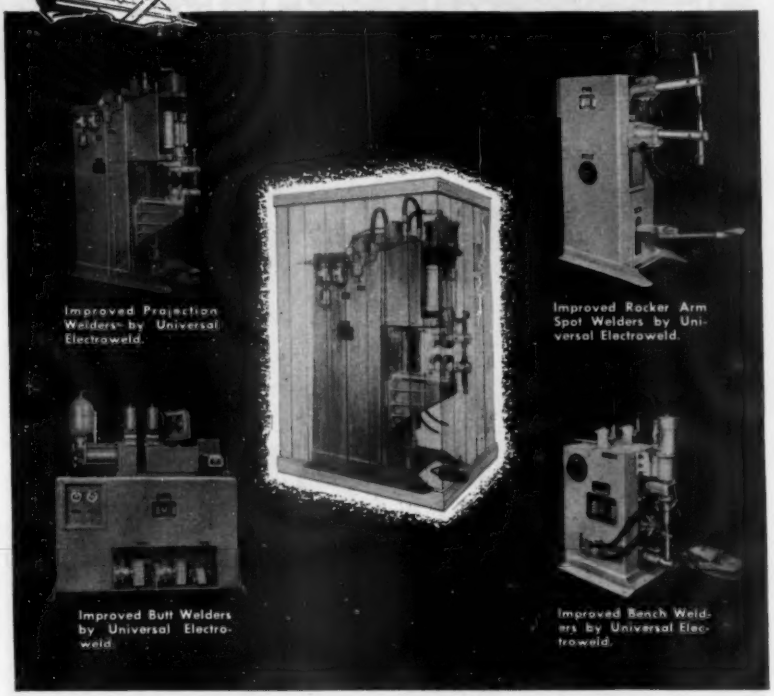
Circle No. 13

Scanning machine

Model T-24 Floating Zone scanning machine makes possible precise production of ultra-pure metals and semi-conductor materials. An extremely narrow molten zone is maintained through bar cross-section by a phenomenon of electromagnetic forces, surface tension and hydrostatic pressure. Machine will process bars up to 1.250-in. diameter and 24-in. in length. Scanning speed is continuously variable with an approximate range of 0-12-in. per hour. Automatic arrangement can scan a predetermined length at pre-set speed, then return at pre-set speed to starting position with continuous repetition of the cycle. *Induction Heating Corp.*

Circle No. 14

Profit through E.A.I. Research


Improved Projection Welders by Universal Electroweld.
Improved Rocker Arm Spot Welders by Universal Electroweld.
Improved Butt Welders by Universal Electroweld.
Improved Bench Welders by Universal Electroweld.

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WELDING BREAKTHROUGH

• More Versatile and Durable Resistance Welders at Major Savings!

Welders made for a quarter-century of high production without major repairs . . . rams that never need replacing . . . Lineal Ball Bearing sleeves instead of cam rollers . . . *Heat-Vector®* control that brings 3-phase welding performance to single phase welders . . .

These are some of the advances that come packaged in today's new Universal Electroweld Single Phase Welders . . . the most practical ever developed for resistance welding. They bring new flexibility and precision to resistance welding . . . with major savings on your initial investment . . . reduce installation, maintenance costs.

RENTAL AGAINST PURCHASE . . . an easy way to see for yourself how you can gain by using Universal Electroweld Resistance Welders.

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DEMAND THE BRAND MADE BY PEOPLE WHO BUY YOUR PRODUCTS

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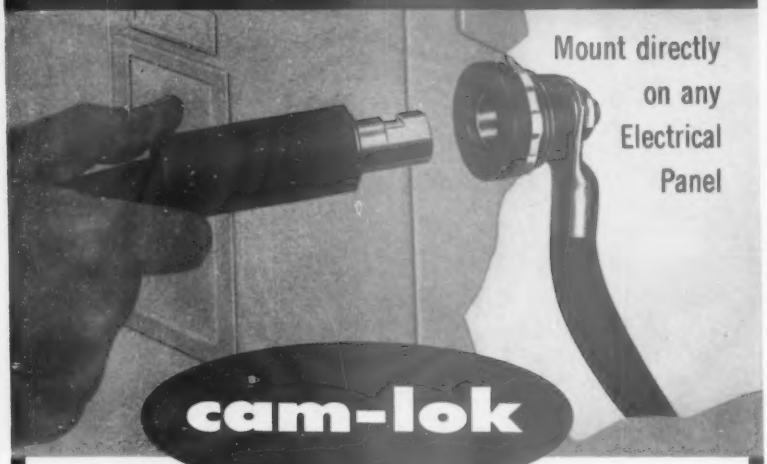
ELECTRIC-ARC INC.

New Hi-Impact Plastic Insulated Panel Receptacles and Mating Plugs



Now, you can make fast, positive power connections to any metal panel or housing without special insulating materials. Simply punch out a hole and insert a Cam-Lok self-insulated Receptacle! Uses standard electrical lock-nuts, affords "dead-front" protection. Push in and twist Cam-Lok mating Plug and you've made a locked connection, which can be released quickly.

New Cam-Lok Receptacles eliminate costs of special insulating panels and reduce assembly time. Patented, high-pressure contact assures minimum resistance and heating.

Cam-Lok has a complete line of Receptacles and Plugs in many sizes and designs. Standard and special purpose Power Distribution Connections are available. Write today for new Bulletin No. 301.

"Dead Front" design for fast
direct mounting on . . .

- **ELECTRICAL DISTRIBUTION PANELS**
- **SWITCHGEAR**
- **BUS DUCT**
- **JUNCTION BOXES**
- **WIREWAY or any electrical cubicle**

A Complete Line of Welding Accessories and Special Power Distribution Connections

cam-lok DIVISION

EMPIRE PRODUCTS, INC.
P.O. BOX N-98
CINCINNATI 36, OHIO

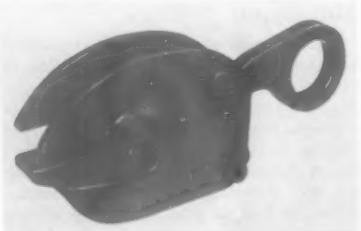
Voltage compensator

Automatic voltage compensator shifts phase of firing pulses which control the heat regulating function of thyratons within the power rectifier cabinet. By advancing the phase of these pulses when line voltages surge or drop with plus or minus 10%, weld current can be held to within plus or minus 2% or less at any given setting on heat control dial. *Sciaky Bros., Inc.*

Circle No. 15

Non-marring clamp

Claimed by manufacturer to be first of its kind developed, non-marring clamp is designed to lift stainless steel, copper, aluminum and other polished metals. Model NM is characterized by smooth-ground jaws with



no teeth. Finger-adjustable wedge on one side of the jaw and 5 to 1 gripping ratio on opposite side provide a positive grip. Manual manipulation of wedge-screw adjustment permits locking and unlocking. *J. C. Renfroe & Sons.*

Circle No. 16

Tensile tester

Interchangeable "load cells" are feature of model LPT testing machine. Designed to perform all manner of tensile and compression strength tests within relatively low lead capacities, it allows use of four different load cells, each providing a different maximum load (100, 200, 600, and 1,000 lb) with gages and graduations to match. The 115-volt, electric motor-powered, hydraulically operated mechanism is completely independent of the load measurement system. Tensile test specimens up to 3/6-in. thick, 1-in. wide, and 12-in. long and compression test specimens up to 4-in. diameter and 6-in. high can be accommodated. *Detroit Testing Machine Co.*

Circle No. 17

Combination positioner

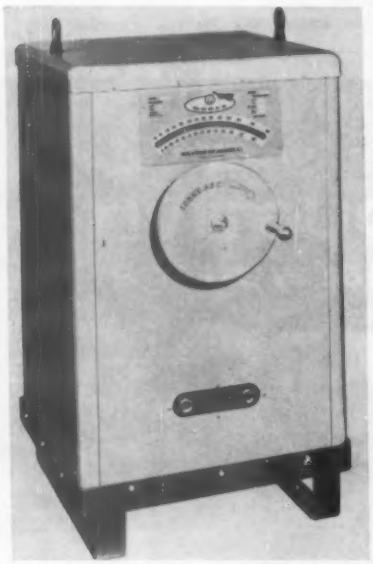
Economy combination longitudinal and circumferential positioner utilizing a single, common Tig welding head station, carriage, track, power supply and control is capable of extremely accurate welds in any metal without changing power supplies. The machine will weld piece-parts up to 72 in. in length and diameters between 4½ in. and 52 in. at a speed up to 48 ipm. Longitudinal weld accuracy is 0.005 in. or less (including runout) in both vertical and horizontal planes. *Airline Welding and Engineering Co.*

Circle No. 18

Bending machine

Line of bending machines for pipe, tube, angles, channels and other structural shapes are available in four sizes, to handle work from .6 section modulus to 18.0 section modulus. The unit employs hydraulic power, has a 90-deg-plus springback on one setting, 180-deg-plus springback on second setting. *Wallace Supplies Mfg. Co.*

Circle No. 19



Welding machines

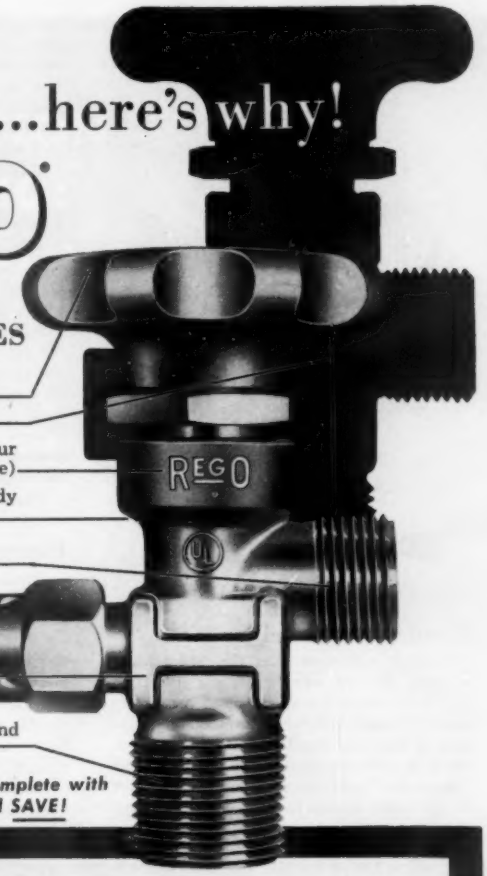
A-c industrial arc welding machines designed for heavy-duty production provide optimum arc characteristics and stability over a wide variety of electrode types and sizes, manufacturer says. Dual coil transformer design provides balanced wave output for a smooth, stable arc under all welding conditions. Full 75-volt open circuit is provided for instant arc starting. Forced air cooling protects transformer against extra-heavy loads. Minimum-travel steel shunt eliminates the need for moving coils. *Metal & Thermit Corp.*

Circle No. 20

best buy...here's why!

REGO

850 SERIES CYLINDER VALVES


Uplift Wheelhandle
Plenty of Clearance Here
Customizing Available (Your symbol or name embossed here)
Low Silhouette Forged Body Design
Choice of Outlets, even Female CGA 581-591
Thoroughly Proved Safety Devices For Every Application
Standard 1⅛" Wrench Flats
¾" NGT Inlet Thread (Extra Long); Oversize, 1" and ½" also available
REGO

Do you order cylinders complete with valves? Specify RegO and SAVE!

THOROUGHLY FIELD-PROVEN
Thousands in use under all conditions

THOROUGHLY SAFE
Safety devices for every rating and application

DOUBLE SAVINGS!
Save on original cost—save on shipping charges: 20% lighter than old-style valves

LONGER, MAINTENANCE-FREE LIFE
Nylon packing; automatic take-up never needs adjustment

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Please send us free information about:

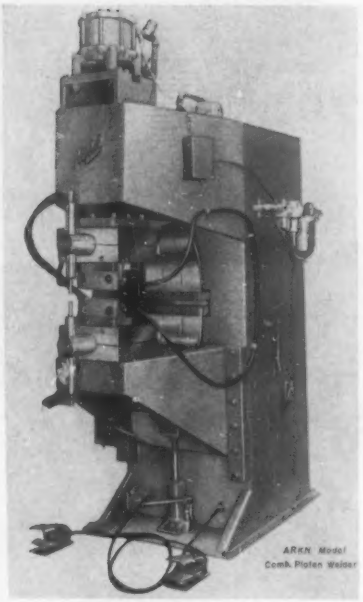
☐ the 850 Series Valves
☐ RegO Valve Custom-izing Service (Your symbol or name embossed on valve body.)
☐ RegO Engineering Advisory Service

Name_____

Company_____

Address_____

City_____ Zone____ State_____



Combination welder

Specially designed for the sheet-metal, wrought iron and wire fabricating industries, the new combination spot and projection welder, model ARKN, features combination large platten and standard arm arrangement, precision roller-bearing ram, high speed, and ruggedness. Easy up-and-down adjustment of the lower extension arm is provided by a hydraulic jack. Platten bed is made of high electrolytic bronze. Self-adjusting pressure switch maintains sure pressure firing. Two-stage foot switch allows selection of manual or high-speed automatic operation. Available in current capacities from 50 to 200 kva. *Alphil Spot Welder Mfg. Corp.*

Circle No. 21

Load control

Automatic welder load control system continuously monitors welding line to determine current load, voltage drop, and how much additional load the line is capable of handling without dropping voltage below the preset value. Bad welds due to excessive voltage drop are eliminated. Equipment consists of single master control and a load control unit at each welder. The master control has meters on its front panel to provide a picture of line level at all times. *Instrument Control Co.*

Circle No. 22

Electrode

Designed for joining crack sensitive steels and other low weldability steels, new electrode, Certanium 707 provides tensile strength up to 120,000 psi, with yield strength up to 90,000 psi. Due to coating formulation a minimum of carbon pick-up from base metal dilution results during welding, reducing carbide stress points and poor machinability. Balanced austenite ferrite ratio in the weld deposit tends to prevent crack formation. *Certanium Alloys and Research Corp.*

Circle No. 23

A-c voltmeter

Improved readability and a 40% increase in accuracy are highlights of new a-c voltmeter. Calibrated from 110 to 130 volts, the instrument provides readings accurate to within plus-minus 0.36 volts, according to manufacturer. Zener diode circuit feeds milliammeter element, which spreads 110-130 volts over 95% of the scale length. Available for both 50/60 and 400 cycle duty, 4¼-in. flanges may be obtained. *General Electric Co.*

Circle No. 24

Oxide remover

Oxide, scale, and heat discoloration are removed from aluminum by a one-step method with cleaner liquid. Procedure may be used to clean aluminum before welding, to remove discoloration after welding, soldering, or heat treating, and to level off minor scratches and mars. Shipped in polyethylene "cubitainer." *Chemclean Products Corp.*

Circle No. 25

Cutting machine

Designed for heavy-duty work in metalworking shops, factories, steel mills, foundries, etc. this abrasive cutter has capacity to cut all metals up to 4-in. solids; 5½ in. O.D. pipe or tube; 6 x 1 in. flat stock; 6 in. angle iron; and 8 in. channel iron. Rate of cut is between 2 to 3 seconds per sq in. of metal cut. *American Chain & Cable Co., Inc.*

Circle No. 26

on "tough" snagging and grinding operations . . .
. . . if PRODUCTIVITY is what you want!
PRODUCTIVITY is what you get!
with the
VEE-ARC
2 HP PORTABLE GRINDER

This **NEW** powerful but light-weight grinder does **MORE WORK** with less operator fatigue . . . **DESIGN-ENGINEERED** for use with **9"** disc wheels . . . can be plugged into nearest 120-v. AC power outlet . . . **LIFE-TIME LUBRICATED** . . . **TAMPER-PROOF SEALED** . . . **SIX MONTHS WARRANTY.** All this . . . and more for only **$168.00** f.o.b. nearest distributor.

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Dept. WE WESTBORO, MASSACHUSETTS U.S.A.

Tell me more about this Vee-Arc Portable Grinder:

Name_____

Firm_____

Address_____

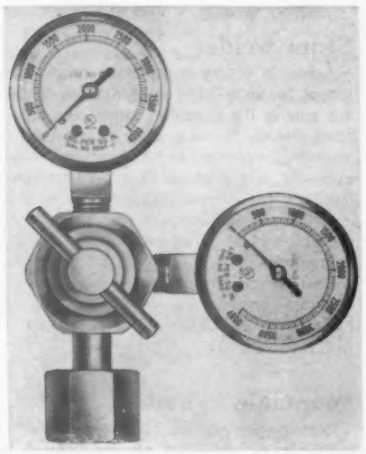
City_____ State_____

POWER . . . PRECISION . . . PERFORMANCE . . . **PRODUCTIVITY**

Ultrasonic degreaser

Self-contained ultrasonic degreaser removes metal chips, grease, and certain insoluble soils from intricate parts. Components in small motors, electronic sub-assemblies, and bearings can be ultrasonically cleaned without dismantling. Model AC-25 measures 44 x 18 x 36 in., uses 110-v, 60-cycle electrical connections. Water cooling system limits evaporation loss, and automatic interlock shuts off the sump's strip heaters if cooling system fails. *Branson Ultrasonic Corp.*

Circle No. 27



Pressure regulator

Compact, diaphragm type pressure regulator can be used in any location to reduce pressures up to 3,000 psi to any pressure from 0 to 1,500 psi. Slightly less than 6 in. in overall height, it is especially suited for use in gaseous oxygen service where a relatively light flow is required. Wide variety of inlet connections is available for any high-pressure, non-corrosive gas. *Bastian-Blessing Co.*

Circle No. 28

OPERATION
WELDING:
at Space Station #1
Located 1,075 miles above the earth and traveling 15,840 miles per hour in surroundings where there is no atmosphere or weight, where the sun's rays may heat an object to 4,000°F., and where hazards like cosmic radiation are ever-present, will be Space Station #1 — the construction site for the first moonships.
Can existing welding methods be employed on these moonships under such environmental conditions? What special welding equipment will be needed? In preparation for man's first trip to the moon, RACO engineers are researching these and other critical space age questions. For forty years, RACO has touched on the borders of tomorrow, anticipating and meeting the diverse welding needs of industry.
RACO utilizes the most advanced automation techniques to produce all grades of precision welding wire drawn to rigid metallurgical specifications, and a complete range of welding electrodes engineered to fulfill all requirements with complete reliability.
Welding Reliability Begins with RACO
RACO
REID-AVERY COMPANY, INC. DUNDALK, BALTIMORE 22, MD.
Write today for the complete RACO catalog.

no matter what the two metals are . . .

now you can **SOLDER** them

PROBLEM:
Joining copper pipes in extremely hard water area. Lead solders made porous joints. Heat required for high temperature solders burned copper pipes.

SOLUTION:
All-State's #430, a silver-bearing solder which flows at 430F, made perfect, permanent joints, solved the problem.

ALL-STATE has a solder for joining any commercial metal or alloy to any other . . . in one or more temperature ranges. For typical examples, see tables below:

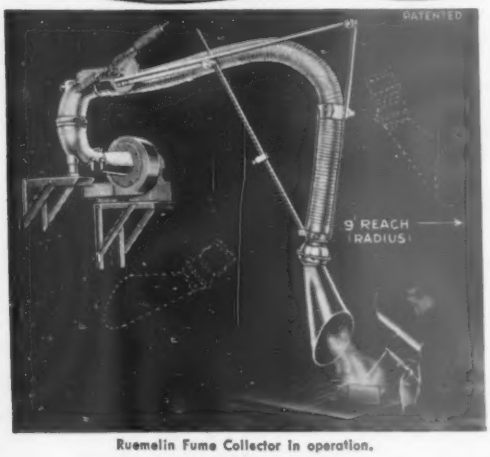
400°F-500°F							700°F-800°F					
Al.	Copper	Brass	Steel	S.S.	Nickel		Al.	Copper	Brass	Steel	S.S.	Nickel
37	107	107	107	107	107	Aluminum	56	105	105	105	105	105
107	430	430	430	430	430	Copper	105	105	105	105	105	105
107	430	430	430	430	430	Brass	105	105	105	105	105	105
107	430	430	430	430	430	Steel	105	105	105	105	105	105
107	430	430	430	430	430	Stain. Steel	105	105	105	105	105	105
107	430	430	430	430	430	Nickel	105	105	105	105	105	105

Reference numbers above indicate All-State solder to be used for joining metals.

A set of four complete tables, covering temperature ranges from 400F to 800F, is yours for the asking. Send for free Instruction Manual, too.

Distributor-Stocked, convenient to buy. Economical to use.
ALL-STATE WELDING ALLOYS CO., INC., White Plains, N. Y.
Call WHite Plains 8-4646 or write for nearest distributor

"It certainly is a relief to have fumes and heat removed while I'm welding. The Ruemelin Collector has great suction. It makes a day's work pleasanter!"



Ruemelin Fume Collector in operation.

Welding shops equipped with Ruemelin Fume Collectors are assured of a clean shop atmosphere. Noxious fumes, heat and smoke are eliminated at their source, thus improving working conditions, lessening fatigue and paving the way for increased plant production.

The Ruemelin Fume Collector hood can be instantly placed where needed anywhere in the booth welding area. No tedious adjustments necessary. Just pull the inlet hood to the welding position and you are ready to go.

Note the new spring-loaded counterbalance mechanism which makes Fume Collector much easier to handle. Ask for Bulletin 37-E illustrating this new feature.

RUEMELIN MFG. CO.
MANUFACTURERS AND ENGINEERS
SAND BLAST AND DUST COLLECTING EQUIPMENT
3880 NORTH PALMER STREET • MILWAUKEE 12, WISCONSIN, U. S. A.

Portable x-ray unit

Power of 300 kv, penetration capability of 4-in. steel and a total net "carrying" weight of 150 lb are combined in a new portable X-ray unit. Baltograph 300 X-ray head measures 46¼-in. long by 12¼-in. in diameter. Enclosed in head is the X-ray tube, lead shielding, HT transformer, filament heating transformer, automatic thermal cut-off device and receptacle for control panel connector cable. Control panel is enclosed in a dust and weatherproof metal cabinet and includes a penetration meter, penetration selector. MA presetting control and automatic reset timer powered by push button. X-ray head case has additional space for tools, accessories, and cables. Cases are specially lined with latex-locked curled hair for the absorption of transit shock and vibration. *Balteau Electric Corp.*

Circle No. 30

Seam welder

Lower inventory in expensive copper alloy spares, longer roll life and fewer roll changes are among the benefits claimed for special seam welder. Dressing cycle is less than 60 seconds; frequency can be preset or initiated manually. Cut is made at a predetermined, constant, fixed depth. When wheel must be changed, design permits replacement of entire roll and shaft assembly in less than 2 minutes. Radial accuracy for precision turning is provided by a special set of straddle bearings mounted on each roll. *National Electric Welding Machines Co.*

Circle No. 31

Adaptable cylinder

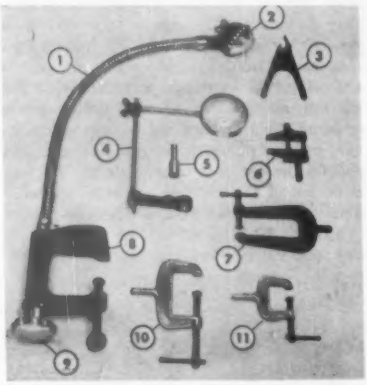
"Powrmation" series of low pressure air and hydraulic cylinders can be adapted to almost any installation, due to wide variety of mountings, rod diameters and rod ends, manufacturer claims. Offered in 1½ in. through 8 in. bores, the cylinder capacities are 250 psi air and 400 to 1000 psi hydraulic, depending on bore size. Choice of packagings meets high or low temperature requirements and special requirements of various fire resistant hydraulic fluids. Also featured is check seal cushion to minimize destructive effects of heavy or high speed loads, and pressure safe tube seal to guard against leakage. *Hanna Engineering Works.*

Circle No. 32

Heavy duty torch

Fast removal of large areas of metal can be accomplished with heavy duty torch using large sized electrodes, 5/8 in. and 3/4 in. Model H-6 can be used on any application requiring high currents for maximum speed in metal removal, as well as casting conditioning in foundry cleaning rooms. Forward section of torch handle and positionable head both have protective sleeve of silicone glass laminate. Special rubber boot provides safety cover for the electrical connection on the end of torch cable. *Arc-air Co.*

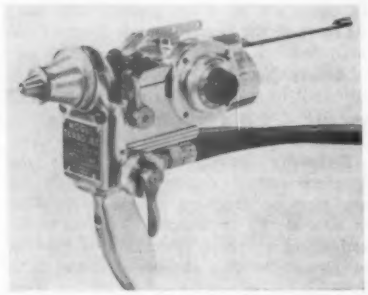
Circle No. 33



Flexible positioner

"Handy hand" flexible bench model positioner holds work piece at any angle. Designed for easier welding or soldering of small assemblies and work pieces, it will hold up to approximately 3 lb rigid in any desired position. Special aluminum bench clamp fastens to any 2 in. table or bench. On the end of the flexible shaft is a rotating positioning head which can accommodate simple adapters with 1-in. spring clamp, 1-in. C-clamps, magnifying glass, magnetic holders, etc. *Superior Welding Co.*

Circle No. 34



Spray gun

High-pressure, high velocity spray gun for applying ceramic coatings to metal and other non-porous surfaces has been successfully used in coating combustion chambers and exhaust nozzles of rockets. Gun applies an even, fine mist of protective coating that can be built up to specified thicknesses. Manufacturer claims equipment produces a protective surface relatively invulnerable to intense heat or severe cold. *Metallizing Co. of America, Inc.*

Circle No. 35

NATIONAL CARBIDE
IN THE RED DRUM

HIGHEST QUALITY

DUST FREE

DEPENDABLE SUPPLY

Write for the name and address of the NATIONAL CARBIDE supplier nearest you.

National Carbide Company

A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

GENERAL OFFICES: 150 EAST 42ND STREET, NEW YORK 17, N. Y.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT

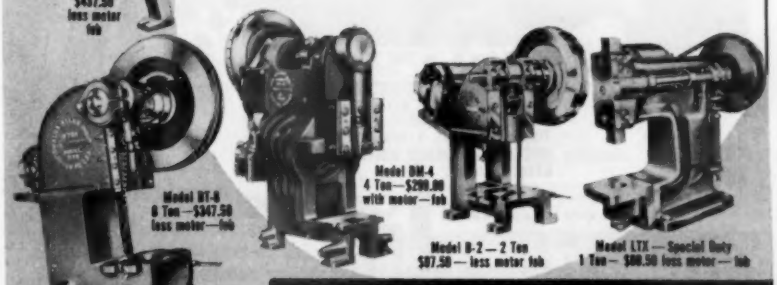
ALLEN
HEAVY DUTY PUNCH PRESSES

POWERFUL • DEPENDABLE
ECONOMICAL
FULLY GUARANTEED

Hundreds of different Model Combinations 1 to 12 ton Capacities

Moderate in Price

See your Supply Dealer or write for catalog giving complete information, specifications and prices on our line of Heavy Duty Punch Presses.



ALVA ALLEN INDUSTRIES, Dept. WE
Clinton, Missouri Tel. TUrner 5-3331

Eliminates Spatter Grinding After Welding

YORK'S *SPAT-R-PRUF* COMPOUND 106

THREE *EASY* STEPS

1. Coat Surface
2. Weld
3. Wipe Off

A perfect paint base. No stirring or dilution necessary. No grinding after welding—spatter can be wiped away with a dry cloth.

IMPORTANT FEATURES

- Non Toxic
- Non Inflammable
- Pleasing Odor
- Harmless to Skin
- Helps Prevent Rust
- No Weld Porosity

Available in 1 gallon cans and 5 gallon cans and 55 gallon drums.

3-IN-1 YORK'S '77' SPECIAL FLUX

- For General Brazing
- For Cast Iron Welding
- For Cast Iron Brazing

A guaranteed bond even under toughest conditions

Available: 1 lb. Cans

YORK ENGINEERING COMPANY

2711 S. KEDZIE AVENUE • CHICAGO 23, ILLINOIS

...AND NOW IS THE TIME TO MAKE IT BECAUSE:

1. COYNE ACETYLENE CYLINDER PRICES WILL NEVER BE LOWER. 2. COYNE CYLINDERS APPRECIATE IN VALUE THROUGH THE YEARS—AND LAST VIRTUALLY A LIFETIME. 3. YOU NOW GET THE "EXTRA DIVIDEND" OF GREATER GAS CAPACITY IN EVERY COYNE CYLINDER.

WRITE OR CALL THE NEAREST COYNE OFFICE FOR DETAILS

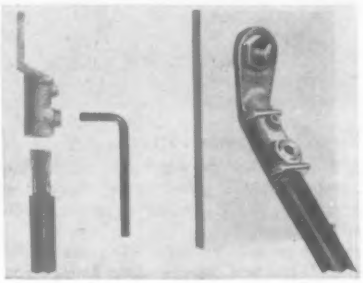
COYNE *cylinder company*

DEPT. WE1 224 RYAN WAY, SOUTH SAN FRANCISCO, CALIFORNIA. PLAZA 6-6910
DEPT. WE1 155 WEST BODLEY AVENUE, MEMPHIS, TENNESSEE. WHITEHALL 8-7789
DEPT. WE1 3900 SPRINGDALE STREET, GLENVIEW, ILLINOIS. PARK 4-3828
DEPT. WE1 24 COMMERCE STREET, NEWARK, NEW JERSEY. MITCHELL 2-1618

Simplified instrumentation

Complete and simplified instrumentation for measuring and recording current flow and voltage on the primary side of resistance welding machines consists of a split-core toroidal coil, a current transformer, a potential transformer and a dual-channel magnetic oscillograph. Since all components are integrated in design and calibrated for the job, no amplifier or other equipment is required. By recording the current and voltage input of the welding machine, the unit enables the operator to regulate the electrical output of the machine to obtain optimum welding conditions. *Control Devices, Inc.*

Circle No. 36



Ball-point lug

Ball-point type mechanical lug can be quickly and easily attached to stranded welding cable. Formed of high conductivity copper, the lug barrel is tapped to accept a cadmium plated steel, ball-point screw. Design of lug is said to assure that every strand of cable will be under pressure and carry its share of the electrical load. *Tweco Products, Inc.*

Circle No. 37

Pipe protractor

Protractor quickly and accurately determines correct degree of an angle on any pipe or structural material regardless of size. Device is clamped on layout table, and string is run to center line of pipe to be joined. To find degree of angle of a fixed object, protractor is simply set level along center line and read. Can also be used to cut tube turn and to find length of cut-back. *Contour Sales Corp.*

Circle No. 38

Safety spectacles

"Unispec Twins" safety glasses are made to fit every face easily. Two models cover five bridge sizes. Model 7446 fits 18, 20 and 22mm bridges; model 7448 fits 22, 24 and 26 mm sizes. All models fit a 22 mm bridge. *Glendale Optical Co.*

Circle No. 39

About people . . .

McKeighan

Mitchell

J. S. McKeighan, Milwaukee District manager for the Lincoln Electric Co., Cleveland, has been named "Man of the Year" of the company's sales engineering organization. The company cited him for his record in the sale of welders, welding electrodes and accessories, electric motors, and battery chargers.

A. O. Smith Corp., Milwaukee, has added *Edward P. Mitchell* as a sales engineer to the Eastern region sales staff of its Welding Products division. In his new job, Mitchell is responsible for welding electrode and machine sales in New York City and surrounding New Jersey counties.

Recently appointed regional sales assistant of the midwest region of National Cylinder Gas Div., Chemetron Corp., Chicago is *Robert L. VanHorn.* He transfers to Chicago from Evansville, Ind., where he served as sales representative during the past three years.

John M. Fox has been appointed to the newly-created position of director of manufacturing of Black & Decker Mfg. Co., Towson, Md. Fox, who has the longest record of service of any employee in the company, will be responsible for all phases of operations connected with manufacturing, including quality control.

Black & Decker also promoted several men effective the start of this year. The new executives are: *John L. Bennett,* to product development manager; *Robert H. Riley, Jr.,* to technical services manager of engineering; and *Samuel H. Kohler,* to product development supervisor in engineering. *William S. Brucker* will be engineering manager of the Master Power Corp., Bedford, Ohio, a subsidiary of B&D.

Miss Liberty says:
"CONFIDENTIALLY I PREFER A Dockson TORCH"

Dockson Welding and cutting torches are lighter, better balanced, built to last with rigid, silver soldered one piece construction. Designed to do the job better, faster.

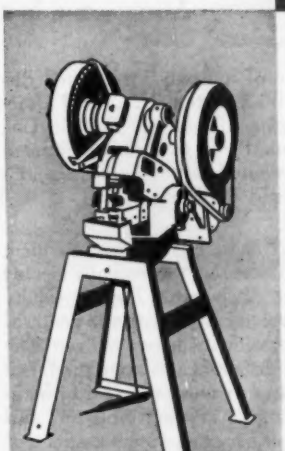
Service parts available from stock.

Check the complete Dockson line of Better Built Welding Equipment. Write for catalog 56-05.

Dockson CORPORATION

3839 Wabash Ave., Detroit 8, Mich.

BATEMAN BANTAM IRON WORKER



THE ONLY IRON WORKER OF ITS KIND ON THE MARKET TODAY

No Grinding Necessary After Cut. One Stroke Cycle Clutch Operater by Hand or Foot

The Bateman "Bantam" cuts 2" x 2" x ¼" angles and ¼" x 4" flats. Standard punches will fit this machine. The Coper will cope 1¼" through ⅛" material. It will punch ½" hole through ¼" material. With the clutch open, the Bantam will make 44 strokes per minute. It is made of high-grade cast iron, with the clutch, pin and dog made of hardened steel. The blades are made with tool steel. It is powered with a fly wheel and gear drive, and uses a small ¾ hp motor, 1750 rpm.

Bateman Bantam with punch....$575.00
Shear only $495.00
Shipping wt. 750 lbs.

WRITE TODAY for complete information and name of nearest distributor

BATEMAN FOUNDRY & MACHINE
MINERAL WELLS, TEXAS

NEW!
Improved Efficiency
SILVER BRAZING FLUX

KWIKFLUX
490

Improves Quality
... Cuts Costs!

Features:
- Greater Heat Tolerance
- Extreme Fluidity at Brazing Temperatures
- High Dilution Factor
- For Use from 1100° to 1700°F.
- Crystal Free

KWIKFLUX 490 contains all the refinements and know-how gained in over a quarter century of flux manufacture.

Prove it to yourself. Write on company letterhead for

FREE WORKING SAMPLE NOW!

SPEC SPECIAL CHEMICALS CORP.
100 SOUTH WATER ST., OSSINING, N. Y.

QUIK HEAT

up to 2200° F.

CLEMENTS
Cadillac
MODEL K
BLOWTORCH

Here's a big, efficient blowtorch for all kinds of heat treating and production processes—yet it is completely and easily portable. Operates economically on either natural or manufactured gas. Produces heat up to 2200° F. in seconds! 1/3 h. p., Universal Motor. Sealed, precision ball bearings require no oiling. Equipped with metal stand, 10 ft. of gas hose and 20 ft. of reinforced rubber covered Underwriters' Approved cord with plug.

ask for BULLETIN

CLEMENTS MFG. CO.
6645 S. Narragansett Ave., Chicago 38, Ill.
SINCE 1910
INDUSTRIAL PRODUCTS DIVISION

Dale W. Gierke has joined National Cylinder Gas Div., Chemetron Corp., as quality control manager, in which position he is responsible for inspection of parts and products manufactured at the division's equipment plant in Chicago, and for establishing control procedures and methods.

Dr. Augustus B. Kinzel has been named by the American Institute of Mining, Metallurgical, and Petroleum Engineers for its James Douglas Gold medal. Kinzel is vice-president of research for Union Carbide Corp., New York City. Among other honors, he numbers the IAA Morehead Medal and the AWS Miller Memorial Medal.

Named as a sales representative for the Rhode Island and Connecticut area by Induction Heating Corp., Brooklyn, is *Robert Harkins.*

Weide

Douglas

Harley B. Weide has been named district representative of southwestern states for Hobart Brothers Co., Troy, Ohio. He will supervise the distribution of the company's arc welding equipment and electrodes in Southern California, Arizona, and New Mexico.

Manager of a newly established district in Washington, D. C. is *William P. Douglas* of Lincoln Electric Co., Cleveland. Prior to the appointment he represented the company in both Buffalo and Pittsburgh.

Jack H. Schron, former vice president of manufacturing, was recently elected president of Jergens Tool Specialty Co., Cleveland, following the death of former president Christy Schron. The board of directors also appointed *Neil J. Redmond* as vice-president of manufacturing to replace Schron, and *Reed T. Weaver* as vice-president of finance.

A. B. Wilber, vice president of Wear-Ever Aluminum, Inc., Pittsburgh and manager of Aluminum Co. of America's process development laboratories, has retired after a 40-year career with the company.

You pay for the best—
BE SURE YOU GET IT!!

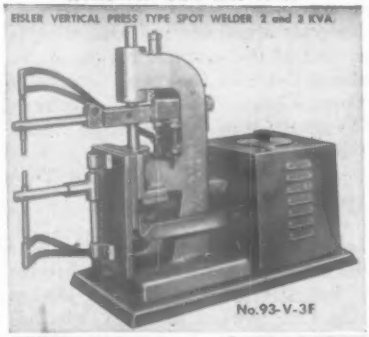
Thousands of welders have been sure of the best by switching to

HI-AMP® ELECTRODE HOLDERS

30% More Heat Resistant than any other make.
Brilliant Red and Yellow Glass Fibre Colors insures identification of Holder anywhere in plant—Valuable Safety Feature.
Low initial cost, easy and economical to maintain.

LENCO, Inc. Weld with HI-AMP
JACKSON, MO.

EISLER VERTICAL TYPE PRESS WELDERS
We also make a complete line of Spot and Wire Butt Welders.
Write for Cat. No. 93-57



EISLER
ENGINEERING CO., INC.
Charles Eisler Jr., President
749 So. 13th St., Newark 3, N. J.

The board of directors of Standard Steel Corp., Los Angeles, has named *Walter J. Kalmeyer* president of the Leader Iron Works. Formerly vice president of manufacturing at Standard's Los Angeles plant, Kalmeyer is a graduate of Carnegie Institute of Technology.

Chatterton

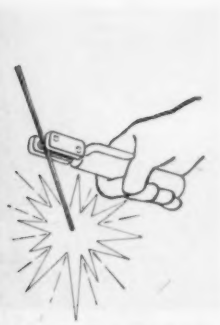
Paul Chatterton has joined the sales department of Fibre-Metal Pacific, Bell Gardens, Calif. He will cover Oregon, Washington, and Idaho on a wholesale basis, calling on distributors of welding and safety equipment.

Ivan C. Sengenberger has been appointed assistant to the manager of operations for the Chicago district of U. S. Steel Co.'s American Steel & Wire division. He was general superintendent of production since 1949, and has been manager of operations since 1957.

H. Buckley Dietrich has been re-elected president of the American Institute of Steel Construction, New York City. Other officers re-elected include *James M. Straub*, first vice president; *Harold G. Lewis*, second vice-president; *M. Harvey Smedley*, secretary; *Erwin P. Stupp*, treasurer; and *L. Abbett Post*, executive vice president.

Robert W. Dunham has been appointed chief engineer of Square D Co.'s Molded Case Circuit Breaker division at Cedar Rapids, Ia. Dunham will be in charge of all design and development engineering for that division. He succeeds *Dr. William Thomas*, who will take over supervision of the company's new corporate research center to be housed in corporate headquarters building in Park Ridge, Ill., when it is completed this summer. In other Square D personnel changes, *T. R. Oakes* has been named vice president and secretary, investing him with top responsibility for finance and accounting. *Henry Morgan*, presently vice president and director, will serve as a consultant with offices in Detroit after the company's move to Park Ridge.

BECKER
Keen-Cut
Electrodes



for use in CARBON ARC-AIR JET GOUGING

KEEN-CUTS—for the best characteristics of carbon and graphite in a carbon arc cutting electrode. Higher current capacity . . . longer life . . . shorter cutting time . . . greater material removal . . . smooth surface gouge . . . controllable accuracy . . . hot stable cutting arc . . . elimination of smoke and gases.

And they're low in cost. Try BECKER KEEN-CUT ELECTRODES—black or copper coated, standard diameters, 12" lengths in 150 to 1400 amp. range—for the most efficient, labor-saving electrode in carbon arc/compressed air cutting.

A COMPLETE LINE OF CARBON AND GRAPHITE WELDING SUPPLIES—carbon and graphite electrodes, carbon rods and plates, welding paste, graphite cores and chills, graphite powder and particles of any mesh.

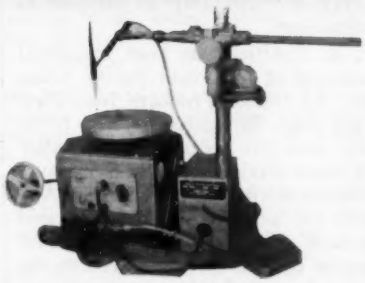
Write for Catalog

BECKER BROTHERS CARBON CO.

3436 South Laramie Ave. • Cicero 50, Illinois

Telephone: BI 2-1260 • Chicago

HELILATHE by SPEED-X

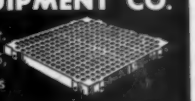


HELILATHE vertical type with SPEED-X Model 100 Welding Positioner.

- ★ Hollow spindle for underneath gas purging
- ★ High voltage insulation transformer
- ★ Manipulator provides complete torch control
- ★ Electronic programming controls
- ★ A standard machine for customized jobs
- ★ Horizontal models also available

STAHL EQUIPMENT CO.

94 Washington St.
Brookline 46, Massachusetts



IN 1936, MORT CLARK, then Vice-President of the world's largest sign manufacturer, wanted a welded galvanized sign frame. Every welder manufacturer said it couldn't de done . . . Mort Clark did it, received a check and certificate of achievement from the Lincoln Welding Foundation—and

MORT CLARK'S GALV-WELD ALLOY ORIGINAL & GENUINE

WAS BORN

The Navy didn't believe, tested it 3384 hours in salt spray (100 hours is normal), then approved it. Westinghouse reports Galv-Weld roof sign, installed 1936—still perfect in 1959—23 YEARS LATER!

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WHY EXPERIMENT?

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Arthur B. Horton was elected board chairman of Chicago Bridge & Iron Co., Chicago. The directors also elected *E. E. Michaels* chief executive officer: *R. F. Hendren*, executive vice president and treasurer; and *E. S. Fraser*, manager of plants.

Promotion of *Clinton V. Newman* to product manager for rod and wire has been announced by Chase Brass & Copper Co., Waterbury, Conn. a subsidiary of Kennecott Copper Corp. He was an outside salesman assigned to the Detroit district office for the past six years.

Two new regional sales manager positions has been created by Cardox Division of Chemetron Corp., Chicago. Appointed to fill the new posts are *Leo W. Vogel*, eastern region, and *Glen E. McCosh*, Pacific region.

Frederick J. Pichard and *Donald A. Swardson* were appointed assistant director of marketing and manager of abrasive and Long-Lyfe parts sales, respectively, by Wheelabrator Corp., Mishawaka, Ind. Pichard will develop special marketing programs in keeping with the company's plans for expansion; Swardson will be responsible for developing and implementing promotional programs and for supporting the abrasive sales force.

Crucible Steel Co. of America, Pittsburgh, has named *Maurice J. Day*, former vice-president—technology, to the newly created post of vice-president—commercial. In this new position, he will have full responsibility for sales management. *W. E. Gregg* succeeds Day as director of technology.

T. A. Rohlfsen has been appointed manager of the South Pacific Coast Div. of Oakite Products Inc., New York City. He succeeds *J. C. Leonard*, who has recently retired after 35 years service with the company. *Bertram Klein* has joined Solar Aircraft Co. as chief of structures and *Hans W. Weickardt* has been named section chief of stress analysis in the research and development engineering division.

Robert H. Coburn and *William A. Grant* have each been appointed district sales managers, electronics controls section, The Budd Co., Philadelphia. Coburn will make his headquarters in Detroit, where he will have overall sales responsibility to the automotive and general metalworking industries. Grant, who was previously employed by North American Aviation as a welding research engineer, will be headquarterd in Los Angeles.

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75. BRAZING MACHINES—Eisler Engineering Co., Inc. Catalog 100-59 describes over 100 types of brazing and soldering machines.

76. ELECTRON-BEAM WELDER — NRC Equipment Corp. Bulletin pictures electron-beam welder used in fusion welding of items previously considered unweldable, such as heat-sensitive assemblies.

77. HEATING UNIT—Lepel High Frequency Laboratories, Inc. Pamphlet gives specifications of portable heat treating unit.

78. FLAW DETECTOR—Branson Instruments, Inc. Reprint T-400 describes operation of ultrasonic flaw detector used in a variety of industries.

79. PASTES AND ADHESIVES—Furane Plastics, Inc. Pamphlet describes adhesives for use with wood, metal, clay, plastics, etc.

80. X-RAY UNITS—Curtiss-Wright Corp. Uses and descriptions of company's portable X-ray machines are covered in pamphlet.

81. ELECTRIC TOOLS—Milwaukee Electric Tool Corp. Condensed catalog G8 details company's drills, saws, grinders, hammers, sanders, polishers, other products.

82. TESTING UNITS—Magnaflux Corp. FW-400 series eddy current instruments for high-speed defect testing are covered in pamphlet.

83. SHEARING MACHINES — American Pullmax Co. Inc. Leaflet describes several company machines and cutting and forming operations.

84. TEMPERATURE INDICATORS—Markal Co. Company's stick, pellet, and liquid temperature indicators are covered in brochure.

85. DRYING AND BAKING—Dri Clime Lamp Corp. Industrial ovens, generators, and interlocking infra-red sections described in booklet.

86. SPRAY POWDER—Wall Colmonoy Corp. Data Sheet 57 discusses crankshaft metalspray powder.

87. ULTRASONIC CLEANERS — Narda Ultrasonics Corp. Folder of data sheets covers cleaning units and applications.

88. METAL CLEANING—Oakite Products. Inc. Chemistry and techniques of cleaning, electrocleaning, barrel cleaning. and ultrasonic cleaning are among topics covered in 28-page handbook.

89. BRANCH FITTING—H. K. Porter Co., Inc. Flyer describes new connection fitting beveled for welding.

90. STRAIGHTENER—Architectural Iron, Inc. Illustrated bulletin shows straightener and bender for straightening or curving wide variety of parts and fabricated sections.

91. FORGED HARDWARE—Merrill Bros. Catalog H-1 covers large number of clamps, clips, nuts, bolts, shackles, etc.

92. HOSE REEL—United Specialties, Inc. Construction and specifications of welding hose reels covered in pamphlet.

93. SNAGGING WHEELS—Simonds Abrasive Co. Straight and cup wheels and grinding cones described in flyer. Grain and grade recommendations included.

94. POWER UNIT—Westinghouse Electric Corp. Flyer describes surge arc welder and silicon-rectifier power unit. Unit designed specifically for the Nelson stud welding process.

95. RESISTANCE WELDERS — Sterling Utilities Co., Inc. Series of welders, including air and foot operated press-type, pictured in pamphlet.

96. CARBON BRUSHES—Ohio Carbon Co. Catalog 15,B contains cross-cataloged dimensions and descriptions of original brushes and replacement counterparts. Shunt types illustrated for identification.

97. MULTI-ARC WELDING—J. B. Nottingham & Co., Inc. Technology, economics, and other practical aspects of multi-arc welding are treated in 71-page illustrated guidebook. Principles, uses, and advantages of multi-arc welding are explained, with references to specific examples.

98. WELDING POSITIONERS—Aronson Machine Co. Illustrated 4-page engineering bulletin describes complete line of turning roll positioners.

99. GRINDING WHEELS—Cortland Grinding Wheels Corp. Resinoid grinding discs, mounting wheels and spindles covered in flyleafs.

100. REGULATORS—Linde Co. Bulletin describes single- and dual-stage regulators. Includes cross-section diagram of model R-205.

101. FIRE SAFETY—National Safety Council. Illustrated booklet on fire safety discusses precautions in welding.

102. JET FLUX UNITS—All-State Welding Alloys, Co.. Inc. Information on company's Mark III Jet flux dispenser contained in small flyer. Installation instructions included.

103. VACUUM FURNACES—High Vacuum Equipment Corp. Data sheets describe vacuum metallizing unit and horizontal cold wall vacuum furnace.

104. ALUMINUM FINISHES — Sanford Process Co. Inc. Hardcoating of aluminum alloys is subject of brochure. Process which allows aluminum to compete with other metal surfaces is described.

105. VOLT-AMMETER—Engelhard Industries, Inc. Bulletin sets forth qualities of transfer volt-ammeter which takes advantage

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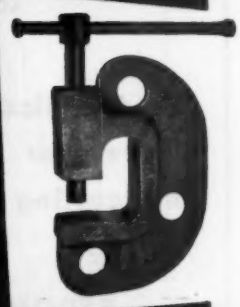

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106. FIRE EXTINGUISHERS—Chemetron Corp. Systems for protection of generators, flammable liquids, paint spray rooms and booths, etc. are discussed in Folio 1-1.

107. SOLENOID VALVE—Automatic Switch Co. New 16-page stock list and selection guide and flow diagrams of every type of company's valves.

108. INCLINABLE PRESSES—Federal Machine and Welder Co. Bulletin 52112 illustrates and describes company's line of presses in capacities from 40 to 200 tons. Also includes charts, sketches and other related information.

109. RADIOACTIVES—Isotopes Specialties Co. Price list of radioactive labeled materials included in illustrated catalog 59.

110. ELECTRIC SHEAR—Milwaukee Electric Tool Corp. Flyer describes 5 lb, heavy-duty, electric shear for cutting galvanized, stainless steel, aluminum, and monel metal.

111. ULTRASONIC EYE—Curtiss-Wright Corp. Portable, versatile immersion testing, quality control installation covered in leaflet. Typical ultrasonic test patterns also shown.

112. INDUCTION HEATING—Lepel High Frequency Laboratories, Inc. Booklet describes induction heating in zone refining, zone levelling and crystal growing.

113. INDICATOR PAINT—Curtiss-Wright Corp. Detecto-temp temperature indicating paint discussed in flyer. All shades and applications available listed.

114. THICKNESS GAGE—Sperry Products Co. Bulletin covers uses, design, and outer appearance of ultrasonic thickness gage.

115. CUSTOM FORGINGS—Merrill Bros. Catalog F-1 describes complete line of drop and press forgings. Technical section with design drawings included.

116. SEMIAUTOMATIC BRAZING — Induction Heating Corp. Semiautomatic brazing of carbide tipped tools is covered in pamphlet IHN-14. Induction heating process also discussed.

117. COMPRESSED AIR—Ingersoll-Rand Co. Booklet 1548 describes compressed air, single-and two-stage compressors, piston displacement, actual delivery, unloading of compressors, regulation and types of control used.

118. HEAT EXCHANGERS—Babcock & Wilcox Co. Technical bulletin 431 contains pictures and text covering all attributes of new line of heat exchanger tubes.

119. HEATING EQUIPMENT—Induction Heating Corp. Recent developments in hardening, brazing, soldering, forging and annealing covered in new 52-page catalog-handbook.

120. HYDRAULIC BOOSTERS — Flick-Reedy Corp. 24-page, three-color bulletin B-200P illustrates and describes operation of process of converting shop air to hydraulic pressure units. Four pages of actual field applications and chart for booster selection included.

121. WELDING MACHINES—Taylor-Winfield Corp. Bulletin depicts some current applications of company's welding machines.

122. CORED ELECTRODES—National Cylinder Gas Div. Chemetron Corp. Welding characteristics and data for four types of continuous fluxed electrodes are contained in a new bulletin, NH-103T.

123. RUST INHIBITOR—Rusticide Products Co. Four-page folder describes how metal treatment stops rust action and provides a sound base for painting.

124. ELECTRONIC EQUIPMENT—Gulton Industries, Inc. Brochure outlines the basic electro-mechanical and ultrasonic product lines of ten divisions and subsidiaries of company.

125. RESISTANT ALLOYS — Carpenter Steel Co. Bulletin outlines applications of company's super corrosion resistant alloys and describes their resistance to corrosive fluids. Tables show comparative resistance of alloys to corrosive media.

126. GRINDING WHEELS—Simonds Abrasive Co. Three bulletins describe operation and list stock numbers for variety of snagging wheels. centerless grinders and depressed center wheels.

127. SAFETY HATS—Fibre-Metal Products Co. Safety hats for use on electrical work in cold climates shown in Form 103.

128. SENSITIVE FILM — Nuclear-Chicago Corp. Pamphlet outlines uses of new sensitive film which permits reporting of radiation doses as low as one milliroentgen.

129. PORTABLE NIBBLER—Fenway Machine Co., Inc. Flyer describes Model EHN heavy duty portable nibbler, which cuts ¼ in. cold or hot rolled steel.

130. PRECISION POSITIONER—The Weldma Co. Operating and production features of company's welding positioner Model SA 40-P-1 are listed in pamphlet.

131. CO_2 WELDING—Hobart Bros. Co. Mig welding of mild steel and low alloy steels with carbon dioxide shielding gas discussed in 38-page booklet.

132. TEMPERATURE MEASUREMENT —Tempil Corp. Seven page booklet covers definition, effects, and measurement of temperature.

133. 17-4 PH STAINLESS—Armco Steel Corp. Four-page reprint of WELDING ENGINEER article tells how to weld the 17-4 PH alloy.

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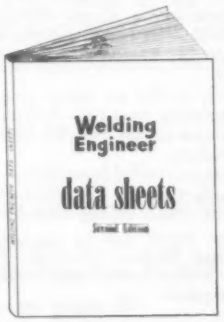

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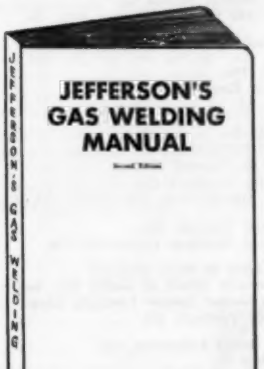

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150. Alloy Rods Co.—A report to piping contractors on "Atom-Arc" iron powder, low hydrogen electrodes is available.

151. All-State Welding Alloys Co., Inc.—Instruction Manual and 4 complete tables covering temperature ranges from 400F to 800F is available.

152. Alva Allen Industries—Catalog available giving complete information, specifications and prices on Allen Heavy Duty Punch Presses.

153. American Platinum & Silver Div.—Reference manual, "A Complete Guide To Successful Silver Brazing' is available.

154. American Platinum & Silver Div.—Also available is "A Complete Guide To Selective Fluxing For Low Temperature Silver Brazing."

155. Anti-Borax Compound Co.—Descriptive circular and free sample of brazing flux available.

156. Atlas Welding Accessories Inc.—Further information available on the Atlas "Wide Blade" tomahawk, and other weld cleaning tools.

157. Bastian-Blessing Co.—Information available on "Rego" cylinder valves.

158. Bateman Foundry & Machine—Complete information on the "Bantam Iron Worker" and name of your nearest distributor is available.

159. Bay-State Abrasive Products Co.—Further information available on the new "Bayflex" double-duty grinding and finishing wheels.

160. Becker Brothers Carbon Co.—Catalog on "Keen-Cut" electrodes, carbon rods and plates, welding paste, graphite cores and chills and graphite powder is available.

161. Budd Co., Electronic Controls Div.—Complete details on the "Monautronic" resistance welding control is available.

162. Budd Co., Instruments Div.—Gamma Radiography bulletins available.

163. Cam-Lok Div.,—Empire Products, Inc.—Bulletin No. 301 on the complete line of Receptacles and Plugs is available.

164. Chicago Boiler Co.—Complete details on the "Red Head" lifting clamps available.

165. Clements Mfg. Co.—Bulletins on "Clements Cadillac Model K Blowtorch."

166. Columbia Electric Mfg. Co.—Write for illustrated catalog on "Tong Test AC-DC Ammeter."

167. Contour Sales Corp.—Information available on "Curv-O-Mark" pipe-layout tools for marking pipes and structural angle cuts of any type.

168. Coyne Cylinder Co.—Further details available on acetylene cylinders made by "Coyne."

169. Dockson Corp.—Catalog 56-05 gives complete information on Dockson torches and other welding equipment.

170. Eastman Kodak Co.—Further information available on Kodak industrial x-ray film.

171. Eisler Engineering Co.—Catalog 93-57 on spot and wire butt welders and the vertical type press welder is available.

172. Electric Arc, Inc.—Write for brochure "New Packaged Welding Advantages" giving data on resistance welding with the new Universal Electroweld single phase welder.

173. Eutectic Welding Alloys Corp.—Further information available on the course offered by Eutectic and a manual on "Low Temperature Welding Alloys."

174. Galv-Weld Products—Information and distributor franchises on galvanized welding, and samples, are available.

175 General Electric Co.—Information on Ignitron tubes manufactured by G-E are available.

176. H & M. Pipe Beveling Machine Co.—Catalog available on H & M equipment including the new "Beve-Land" grinder.

177. Handy & Harman—Bulletin 20 available covering the basics of brazing to solve your metal-joining problems.

178. Handy & Harman—Information available on the new Handy & Harman brazing correspondence course beginning in November.

179. Harnischfeger Corp.—Bulletin W-158 available showing 6 engine-driven models of P&H portable welders for field welding, is available.

180. Harrisburg Steel Co.—Further information available on gas cylinders manufactured by Harrisburg.

181. Harris Calorific Co.—Write for information on Harris cutting torches.

182. Hobart Brothers Co.—Color film available on a loan basis, "Arc Welding Electrode Selection."

183. Hobart Brothers Co.—Further information on the "400 cycle" induction heating unit and The "ElectroniK" Strip Chart controller are available.

184. International Nickel Co., Inc.—Write for data on the new two-pound "MIG" filler wires in spools, and name of your nearest distributor.

185. Invincible Vacuum Cleaner Mfg. Co.—Send for Invincible Flux recovery equipment folder.

186. Jackson Products—Further information available on Jackson's new "Sealed Tight" electrode holders.

187. Lenco, Inc.—Information on "Hi-Amp" electrode holders available.

WELDING INFO-AIDS

USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

NEW PRODUCTS described on pages 80 to 88

Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

USE POSTPAID CARD →

★ For copies of any manufacturers bulletins described on these pages circle the number of the items on card at right. Fill in your name, title, company and address. This has to be done only once on either post card. You need no postage.

★ For additional information on New Products described in this issue, circle the numbers of the items that interest you. The New Products section begins on page 80.

WARNING!

Illegible or incomplete addresses may keep you from receiving the information you desire. And remember, cards postmarked after the deadline date cannot be processed.

★Post card not valid after three (3) months. After that, write *directly to the manufacturer*, describing fully the information and/or literature wanted.

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Welding Info-Aids,
Welding Engineer
P.O. Box 28
Morton Grove, Ill.

Literature offered in ads . . . continued

188. Lincoln Electric Co.—Prices and details on remanufacturing your welder by the "Lincolnditioning" process.

189. Linde Company—Details on the "Sigmett" torch and where you can try it is available.

190. Markal Company—Literature and pellet samples of "Thermomelt" temperature indicators available.

191. Merrill Brothers—Catalog C-2 available describing over 25 material handling devices.

192. Metal & Thermit Corp.—Data sheets and additional information on M&T Murex welding machines are available.

193. Metalloy Products Co.—Testing sample of "Galvalloy" available for your galvanizing job.

194. Miller Electric Mfg. Co., Inc.—Complete specifications on the new Miller AEA-200-L gasoline engine driven welder/power plant and folder, "How to Thaw Frozen Water Pipes" available.

195. Miller Electric Mfg. Co., Inc.—Further information on the "Big Twin" and "Little Twin" welders will be sent on request.

196. National Carbide Co.—Write for further information on calcium carbide and name of your nearest distributor.

197. National Welding Equipment Co.—Illustrated folder #17 on the combination welding and flame cutting outfit called the "Five Star Pak."

198. Page Steel & Wire Div.—Folder containing information on submerged arc and inert gas automatic welding wire and chart available.

199. Phelps Dodge Copper Products Corp.—Information on Phelps Dodge "Habirprene" arc welding cable is available.

200. Phoenix Products Co.—"DryRod as Standard Welding Equipment" gives data on the "DryRod" line of ovens for moisture proof electrodes and rods.

201. J. M. Ragle Industries—Additional data on the "Commando" round soapstone holder and other "Commando" products is available.

202. Ransome Co.—Write for further information on Ransome welding positioners.

203. Reid-Avery Co.—A complete "Raco" Catalog is available on welding wire and electrodes.

204. Ruemelin Mfg. Co.—Detailed information on the Ruemelin fume collector is available.

205. Shawinigan Products Corp.—Write for further information on calcium carbide and name of your nearest distributor.

206. Shoot-A-Lite Corp.—Literature on "Safety Gas Liter" for welding and cutting torches.

207. A. O. Smith Corp.—Write for further information on A. O. Smith electrodes.

208. Special Chemical Corp.—Write for a free working sample of silver brazing flux, "Kwikflux."

209. Stahl Equipment Co.—Further information on the "Helilathe" vertical type welding positioner available.

210. Stulz-Sickles Co.—Write for literature on the reclamation of worn tractor parts, and name of your nearest distributor.

211. Tec Torch Co., Inc.—Additional information available on air-cooled Tig torches manufactured by Tec Torch.

212. Tempil Corporation—Further information on "Tempilstiks" the temperature indicating crayons, is available.

213. Tennessee Fabricating Co.—Catalog on casting designs, welding rods, tubing and machine tools and supplies are available.

214. Titan Metal Mfg. Co.—Write for folder describing Titan welding rod compositions and uses.

215. Tuffaloy, Div. of Air Reduction Co., Inc.—Catalog and price list on Tuffaloy shanks and Tuffcap tips available.

216. Tweco Products Co.—Write for information on Tweco ground clamps and a copy of "Twecolog" showing the complete line of Tweco accessories.

217. Vee-Arc Corp.—Further information on the Vee-Arc portable grinder available.

218. Victor Equipment Co.—Write for additional information on the "Victormatic" semi-automatic welder and continuous-coil wires for hardfacing.

219. Victor Equipment Co.—Profitable dealerships open in a few areas, if interested circle No. 219.

220. Webb Corporation—Catalog on Webb plate fabricating machinery available.

221. Westinghouse Electric Corp.—Further information on the "Baltospot" X-ray unit available.

222. York Engineering Co.—Additional information on York's "Spat-R-Pruf" compound, to eliminate spatter grinding after welding.

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DOWN-TO-EARTH FACTS about ground clamps

GIVES a quick, positive and portable ground connection.
INCREASES machine and operator efficiency.
ALLOWS proper placement of ground to eliminate arc blow.
MAKES holders and cable run cooler, last longer.
CUTS current consumption. Reduces power costs.

Only TWECO GROUND CLAMPS offer all these features:

Copper Hinge Pin Allows Both Jaws To Carry Current

Strong Spring Fully Insulated

Support Ring Stops Cable Strand Breakage

Extended Lip — Shoves on to Work Easily

Jaws Made of 98% Copper Alloy

Exclusive Ball-Point Cable Connection. Cable Attached in Two Minutes

TWECO GROUND CLAMPS
MADE IN 200, 300 & 500 AMP SIZES

TWECO CABLE CONNECTORS

WRITE FOR FREE TWECOLOG SHOWING THE COMPLETE LINE OF TWECO ACCESSORIES

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MANUFACTURERS: ARC WELDING ELECTRODE HOLDERS, GROUND CLAMPS, CABLE CONNECTORS, TWECO-LITE ALUMINUM WELDING CABLE

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P. O. BOX 666 • Factory: Boston at Mosley • Phone AMherst 5-1684 • Wichita 1, Kansas

MILLER GASOLINE ENGINE DRIVEN WELDER/POWER PLANTS

MODEL AEA 200-L

miller

ELECTRIC MANUFACTURING CO., INC.
APPLETON • WISCONSIN

This Miller AEA-200-L gasoline engine driven welder power plant is a real "powerhouse" — delivers 225 amperes of high cycle welding current plus 1000 watts of 115v d-c while welding. In addition, it produces 5 KW of 115/230v a-c .

Driven by powerful 12.9 h.p. Onan air-cooled engine, the AEA-200-L is a rugged and reliable welder/power plant for use anywhere!

Electric starter and various wheel mounts available. Complete specifications and interesting folder "How to Thaw Frozen Water Pipes" sent promptly upon request.